Bond University

DOCTORAL THESIS

Feasibility analysis in the pre-commitment stages of the property development process: An examination of uncertainty, risk and heuristic bias in management decision making processes during the precommitment stages of the property development process in Australia.

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Feasibility Analysis in the Pre-Commitment Stages of the Property Development Process

An examination of uncertainty, risk and heuristic bias in management decision-making processes during the pre-commitment stages of the property development process in Australia.

Presented by

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Professor Michael Regan and Associate Professor Lynne Armitage

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An investment in knowledge pays the best interest.

- Benjamin Franklin

Sometimes we have to unlearn things before we can learn the right things.

- Kenneth E. Hagin

Abstract

The current practice of real estate companies engaged in property development is to employ industry-accepted heuristics as target rates of return based on benchmarks commonly expressed as hurdle rates of return (Crosby *et al*., 2018a). *Hurdle rates* are a minimum financial metric and are intended to include the developer's cost of capital and a premium commensurate with a subjective assessment of a project's unsystematic risk and are used to measure a potential project's viability through conducting a feasibility analysis and inform decision-making during the early stages of the undertaking. For a project and/or site acquisition to proceed, the forecasted profitability determined through a feasibility analysis must meet or exceed a firm's minimum requirements. Longer-term investment holding periods introduce new risks and uncertainties and require change management mechanisms which are often unidentifiable at the preliminary stages of a project. This is particularly the case with staged developments in many sectors, newly listed assets and infrastructure.

There were three primary aims of this research which are:

Firstly, to complete an examination of the decision-making practices used in determining project viability through conducting a feasibility analysis by real estate development firms in Australia and also to obtain information regarding hurdle rate selection and techniques commonly utilised to determine project viability. This research investigated the drivers and decision-making processes of property developers in Australia and touches on the global practices of the industry as property development becomes increasingly internationalised. Findings indicate the majority of Australian property development organisations do utilise specific go/no - go hurdle rate mechanisms as a decision basis for

proceeding beyond the pre - commitment stages of the development process. Furthermore, few differences were found between property developers with differing primary property types in the use of specific go/no - go decision processes, with the majority using a margin on development cost (MDC) or an internal rate of return (IRR) as a minimum financial metric. Property developers whose preferred project size is large (> AUD 50 million end value) utilise more sophisticated methods of feasibility analysis and have a higher number of specific hurdle rates to guide decision-making.

Additionally, property developers who primarily undertake small project sizes (<= AUD 5 million end value) use less sophisticated quantitative methods of analysis but require a higher return on equity (ROE) as a basis for project selection. The results indicate the structure of many development projects are complex, and the boundaries between traditional speculative development and property investment through the use of securitisation methods have become more difficult to distinguish. The majority of development organisations surveyed do not rely purely on quantitative metrics for determining project viability through feasibility analysis, but also use qualitative methods and organisational specific structural checks as a method of managing the organisation's risk.

Differences were also found in the selection and use of hurdle rates based on developer typologies; multi-national property development organisations operating in multiple geographic regions demonstrated a higher use of qualitative frameworks as a decision-making process. In terms of developer feasibility analysis practices and the use of feasibility analysis programs, the two most frequently used tools included Microsoft Excel and Argus Estate Master DF. The two most frequent methods of determining site value prior to acquisition were the residual land value and DCF methods.

Secondly, this research aimed to examine the relationship between bounded rationality, heuristic bias and management decision-making by property development organisations. Findings indicate the majority of developers in Australia do not have a predetermined process and method for altering or adapting the chosen hurdle rates and benchmarks, even in the presence of an expected change in uncertainty and risk to a potential project. Those developers that do alter hurdle rates do so based on three primary themes which are; altering hurdle rates on the basis of risk analysis and forecasted market conditions; altering hurdle rates based on qualitative frameworks or intuition; and altering hurdle rates based on the project's status of planning approval. Additionally, it was found that the property developers surveyed exhibited bounded rationality and place a heavy reliance on industry-accepted heuristics when both selecting and setting the specific level of hurdle rate metric and determining a potential project's viability.

Thirdly, this research examined the risk analysis methods used to determine a potential project's viability through the use of feasibility analysis. This aim included an investigation into the use of specific techniques including Monte Carlo simulations, Bayesian models and real option theory, finding few development organisations surveyed used sophisticated quantitative risk analysis methods at the pre - commitment stages of the property development process. Additional findings indicate property development organisations possess a high level of confidence in their organisation's ability in both the identification and management of risks which may be encountered in a potential property development project. However, this confidence is not supported in the actual risk management processes used.

Recommendations were formulated in three principle areas by synthesising the results of the analysis of the empirical survey and the literature review. The first area considered the selection and use of hurdle rate metrics that form a go/no-go decision basis for potential projects and site acquisition. The second area dealt with the feasibility analysis practices and methodologies adopted in determining project viability. The final area of recommendation involved the risk analysis techniques used by decision-makers in property development organisations during the pre-commitment stages of the development process.

Consequently, the results of this study have highlighted areas which would benefit from further research. Themes identified include the linking of decision - making practices and hurdle rate selection with project outcomes and developer success ratings; the selection and use of time value of money hurdle rate financial metrics and the use of sophisticated risk analysis methods. Additionally, the results of this study found financial metrics were being used by decision-makers in a manner different than those anticipated, and the usefulness of specific metrics in the application to decision-making concerning potential projects should be further investigated.

Keywords

Bounded rationality, feasibility analysis, hurdle rate, property development, real estate development, risk analysis, scenario analysis, sensitivity analysis.

Declaration

This thesis is submitted to Bond University in fulfilment of the requirements of the degree of Doctor of Philosophy.

This thesis represents my own original work towards this research degree and contains no material which has been previously submitted for a degree or diploma at this University or any other institution, except where due acknowledgement is made.

7th March 2019

Matthew Moorhead

Date

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Research output and publication during candidature

Published and presented conference abstracts

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Ethics Declaration

The research associated with this thesis received ethics approval from the Bond University Human Research Ethics Committee (BUHREC). Ethics application numbers 15151 and 15754, and copies of the approval letters from BUHREC can be found in Appendix C.

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Abbreviations and Acronyms

ABS	Australian Bureau of Statistics
ANN	Artificial neural networks
ANOVA	Analysis of variance
API	Australian Property Institute
AUD	Australian dollar
BUHREC	Bond University Human Research Ethics Committee
CAPM	Capital asset pricing model
CART	Classification and regression trees
CBOE	Chicago Board Option Exchange
CFA	Confirmatory factor analysis
CEO	Chief executive officer
CFO	Chief financial officer
DCF	Discounted cash flow
DT	Decision trees
DNRME	Department of Natural Resources, Mines and Energy
EDQ	Economic Development Queensland
EFA	Exploratory Factor Analysis
FA	Factor Analysis
GAV	Gross Asset Value
GDP	Gross Domestic Product

GFC	Global financial crisis
GST	Goods and services tax
HABU	Highest and Best Use
IPF	Investment Property Forum
IRR	Internal rate of return
LCR	Loan to cost ratio
LDCR	Loan to development cost ratio
LPT	Listed property trust
LR	Logistical Regression
LVR	Loan to value ratio
MDC	Margin on development cost
MPT	Modern portfolio theory
MOU	Memorandum of understanding
NHCA	National Housing Consortium Australia
NPV	Net present value
NOI	Net operating income
NZ	New Zealand
NZD	New Zealand dollar
OCC	Opportunity Cost of Capital
PBP	Payback period
PCA	Property Council of Australia
PCNZ	Property Council of New Zealand

PhD	Doctor of Philosophy
RACFM	Residual Accumulation Cash Flow Method
REDM	Real Estate Development Matrix
REIT	Real estate investment trust
RF	Random forests
RICS	Royal Institution of Chartered Surveyors
ROE	Return on equity
ROI	Return on investment
ROR	Return on revenue
ROS	Return on sales
SD	Standard deviation
SPV	Special purpose vehicle
SWOT	Strengths, weaknesses, opportunities and threats
TDC	Total development cost
UDIA	Urban Development Institute of Australia
ULI	Urban Land Institute
UK	United Kingdom
U.N.	United Nations
USA	United States of America
VRB	Valuers Registration Board

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Chapter 1: Introduction

> *Little is known regarding either the expected or achieved rates of return for property development schemes. This lack of transparency is in contrast to the situation for investment properties where the formation of target return rates has been explored… Many participants in real estate development are not formally benchmarked and academic investigation of how developers form required rates of return is limited. (Crosby, Devaney & Wyatt, 2018a p. 1-2)*

1.1 Purpose of the study

The basis of this research is founded upon many years of decision-making concerning whether to proceed or not to proceed with potential property development projects or choosing between multiple heterogeneous projects. Property investment/development companies engage in feasibility analysis while conducting due diligence as a basis for the decision-making process before committing to the purchase of a property investment and/or development site. The act of conducting feasibility analysis as part of a development appraisal is a necessary and critical initial stage of the overall real estate development process.

The primary focus of this research is to examine and critically assess the methods and processes undertaken prior to an unconditional commitment to proceed with a property development project. The primary purposes of conducting a feasibility analysis for a potential development project are two-fold, firstly to determine likely costs and income and to ascertain potential profitability and cash-flow needs, and secondly, to analyse the uncertainty and risk associated with the project and determine if the potential profitability is sufficient to justify accepting the associated level of uncertainty and risk.

1.2 Context and background

Current practice for real estate companies engaged in property investment, development, redevelopment, rehabilitation and advisory activities is to employ a series of generic hurdle rates based on industry and/or company-specific rules of thumb and industry-wide benchmarks commonly expressed as *hurdle rates of return* (Diaz III, 2010; Havard, 2014; Sah *et al*., 2010; Rowley *et al*., 2014; Crosby *et al*., 2018a). Hurdle rates designate a minimum level of return or profitability which is intended to include the developer's cost of capital and a premium commensurate with a subjective assessment of a project's unsystematic risk. The company and/or project defined hurdle rates are then used to measure project viability and inform decision-making during the pre-commitment stages of the development process. The various methods of determining feasibility and project performance in use today have been developing since the 1970s and commonly include static residual valuation, residual accumulative cash flow analysis and discounted cash flow (DCF) analysis in order to determine a project's net present value (NPV).

Common hurdle rates incorporated into static development appraisals include margin on development cost (MDC) also known as return on cost (ROC), internal rate of return (IRR), net present value (NPV) and/or return on equity (ROE). There exists a large body of financial and academic literature regarding the use and development of the aforementioned methods of assessing projects including significant criticisms of their use. However, there remains a paucity of research and literature in the specific aspect of the selection and application of hurdle rates for property development projects, as demonstrated in the Crosby, Devaney & Wyatt (2018a) quote given at the start of this chapter. Recent studies have demonstrated that the use of common financial metrics from the wider investment financial literature are being used by property developers in the inverse of methods that would be expected (Hutchinson *et al.*, 2017; Crosby *et al*., 2018a).

More recent advances in the literature have recommended the use of real option theory as a model for valuing projects and the inclusion of Monte Carlo simulations as a prescriptive model for assessing scenarios and possible outcomes, but the level of uptake of these methods across the property development industry is not known as it is not recorded.

The research also aims to examine the heuristic 'go' or 'no-go' hurdle rate indicators that practitioners incorporate within the decision-making process as well as gain an understanding of how these practitioners define, measure and/or predict uncertainty and risk, and how that measurement feeds back into the decision-making process. Additionally, through the process of this analysis, it is hoped to gain insights into property developer's practices across different sectors of the industry as well as to differentiate methods of decision making after allowing for various purposes of undertaking the project. Furthermore, an analysis was undertaken to assess the adoption of non-conventional methods of assessment including Monte-Carlo simulations and probability analysis, real option theory, Bayesian models of predictability as well as strategies that do not fit within the normal bell curve which includes the fractal geometry of Mendelbroit/Taleb (Makridakis & Taleb, 2009; Madelbrot & Taleb, 2006).

There is a large body of research which outlines the various stages of the real estate development process as well as their key linkages. For examples see Brueggeman & Fisher (2006, 2011); Cadman & Topping (1995); Isaac *et al.,* (2016);

Kohlhepp (2012); Kohlhepp & Kohlhepp (2018); Long (2012); McMahan (2007); Miles *et al.,* (2008); Peca (2009); Peiser & Hamilton (2012); Preller & Costello (2010); Ratcliffe *et al.,* (2009); Sims & Reed (2015); Wilkinson & Reed (2008); Woodson (2005); Wurtzebach *et al.,* (1994); Zuckerman & Blevins (2003). The current study, which particularly seeks to acquaint the reader with key performance areas that make up the integrated process, conducts a critical literature review as well as an empirical assessment of the decision process or processes engaged within the preliminary stages of the real estate development process. This foundation of theory will create a platform for the addition of empirical evidence on specific decision-making processes that are currently being adopted within the industry through conducting an empirical analysis from a survey of leading industry practitioners and to compile and document the key methodologies used as well as the weight practitioners place upon them. In the post-global financial crisis (GFC) property development and property investment industry, it is critical to gain further understanding of how the risks, uncertainty and decision process are evolving to ensure a reduced likelihood of project failure given an internal or external shock to the property market.

A complicating factor is that not all real estate development activities are short-term with many investors willing to assume early-stage ownership risks to grow value and generate a high return to equity. Longer-term investment holding periods introduce new risks, uncertainties and change management which are often unidentifiable at the preliminary feasibility analysis stage of a project. Additionally, the use of discounting methods within heuristic decision models may lead to a bias against longer-term projects in favour of projects which return capital in the short term. This is particularly the case with staged developments in many sectors, newly listed assets and infrastructure (Regan, 2015).

1.4 Research method summary

A review of relevant literature and prior studies shows there exists a gap in knowledge regarding the selection and setting of hurdle rates and benchmarks for Australian real estate development projects in the pre-commitment stages of the development process. The primary purpose of this research is to inform regarding this gap by gaining an understanding of the decision-making practices utilised within the development industry in Australia. In order to achieve the research objectives, it was essential to seek a comprehensive insight into two major attributes of current decision-making practices: Firstly, identifying the practices utilised in the industry and, secondly, to explore the reasons behind the choice of tools employed that aid decision-making under conditions of uncertainty.

In order to achieve this research objective, the research method adopted for the thesis was a *parallel mixed-method* design that was conducted through a single survey, rather than through a mixed-mode instrumental approach in order to take advantage of the strengths of a combined instrument (Curran & Blackburn, 2001).

The rationale for the selection of this method is discussed below and includes three primary reasons being: First, by having quantitative questions that were immediately followed by qualitative questions allowed participants to respond to questions regarding demographic characteristics and decision practices of the property development organisation, and then expand upon the views of decision-makers within those organisations in qualitative open-ended questions. Second, the use of parallel strands within the same instrument allowed for a much larger sample of qualitative responses than could reasonably be obtained through other qualitative data collection methods. Third, the use of a parallel survey allowed for a far larger reach in both geographic terms and industry scope than would have been practical using primarily qualitative data collection approaches. Finally, the limitations of the research methodology are discussed.

1.3 Research questions

The research questions that frame the focus of this thesis were designed to address the gaps within the relevant literature concerning the hurdle rate selection and decision processes of Australian property developers. The questions were originated with the primary purpose of addressing the research aims which are now discussed.

Research Aim 1:

Determine the role of feasibility analysis and development appraisals in management decision-making, the use of hurdle rate methodologies and forecasting practices, building on decision theory and value management knowledge frameworks. Does theory provide insights into the role of feasibility analysis with new projects?

These broad aims were reformated to provide more specific, operationally effective, research questions (RQ).

- **RQ 1:** Do Australian property development firms use specific go/no-go hurdle rate mechanisms as a decision basis for proceeding beyond the pre-commitment stages of the development process? What are the specific hurdle rates and benchmarks which are currently being used by Australian property development firms?

- **RQ 2:** What are the differences in the hurdle rates and benchmark selections as the basis of go/no-go decisions based on the following factors.

  a. Projects by property types including residential, commercial, retail, industrial, retirement, infrastructure and mixed-use projects.

  b. Projects by development company size and ownership? Publicly listed and private company structured development companies? Large, large-medium, medium-small or small projects.

  c. Projects by tenure, including speculative or trader developers versus develop and hold/investor developers which is more recently referred to as ‘build to rent’.

  d. Does experience influence hurdle rate selection? Test differences between experienced versus novice decision-makers.

  e. Do decision-makers with a specific property-related degree differ in hurdle rate selection and use?

  f. Are there significant differences in hurdle rate selection and use between different geographic regions of Australia and New Zealand?

- **RQ 3:** Do organisations and decision-makers that utilise proprietary feasibility programs differ in their feasibility practices and the selection and use of hurdle rates from those which use Microsoft Excel or create their own feasibility analysis program?

- **RQ 4:** Do Australian development companies use the residual land value method, discounted cash-flow method, residual accumulation cash flow method and/or market comparison method for determining a potential development site's value in the pre-commitment stages of the property development process?

Research Aim 2:

Examine the relationship between bounded rationality, heuristic bias and management decision-making in the presence of volatile externalities with a view to measuring the extent of variable interdependence over time.

a. **RQ 5:** Do development companies have a pre-determined process and method of altering or adapting the chosen hurdle rates and benchmarks? How do Australian property development organisations specify and change the required hurdle rates and benchmarks as a basis of go/no-go decisions in light of increased risk and uncertainty?

b. **RQ 6:** Do development companies demonstrate bounded rationality in their decision-making processes?

The vast majority of decision-making models that have been developed for, and employed by, practitioners to determine whether to proceed with an investment/development project are predicated upon the decision-maker being a well-informed rational *economic man (sic)* as described in Simon 1955 "A Behavioral Model of Rational Choice" (Simon, 1955). Human beings are fallible and therefore the interpretation and application of models must also be imperfect as models are ultimately derived from human behaviour and cash flows are created by human actions making decisions to consume space over time (Black *et al.*, 2003).

However, as any individual required to make a complex decision can testify, the volume of information available and the certainty of the forecast of future variables is invariably limited, which thereby limits the rationality that the decision-maker can possess. This concept of *Bounded Rationality* coined by Simon explains that 'boundedly rational agents experience limits in formulating and solving complex problems and in processing information' (Simon 1955, Chittenden & Derregia, 2015).

Feasibility analysis requires the decision-maker to make assumptions and forecast estimates of all the input and output variables within a project's cash flow. This necessitates a prediction of all internal and external constraints to the project and encapsulates both the systematic and unsystematic risk over variable time frames. Real estate projects are inherently complex and involve the interdependence of many elements and project participants each with their own agenda and decision-making processes. The sheer magnitude of the interdependence of the many variables makes accurate prediction highly unlikely, conceivably approaching impossibility. Makridakis (1981), Makridakis & Hibon (2000) and Taleb (2004) also highlighted an additional problem with predictive models. These models show a high degree of inaccuracy in that they can lead to an illusion that future uncertainty can be accurately assessed and effectively controlled. They argue that we can predict using fractal geometry and that there is a system and patterns within chaos.

For example, in order to complete an NPV calculation of a property investment the decision-maker is required to forecast the net operating income (NOI) over a period of time which would normally be five to ten years. This requires the assumption of market rent not only at the time of purchase or post-development, but through any possible changes in the real estate property cycle. The real estate cycle is dependent on numerous variables including the general economic cycle, unemployment, tax policy, supply of comparable properties, the credit cycle and countless other economic factors both locally, nationally and globally. With the increasing interdependence of economies and capital markets, the bounds of influence have become increasingly large and hard to define, as experienced during the global financial crisis (GFC) and pointedly described in Acharya & Richardson (2009).

So how does an analyst make a reliable forecast of this variable which is just one of many? Analysts are not able to find perfect solutions based on complex models but are looking for the best approximation they can make in order to allow them to make a decision. The analyst does not have the luxury of not making a decision but is forced to choose the best alternative of the many imperfect choices and described in Diaz III (2010, p. 204) as follows:

> *There is great inefficiency in the market; there is significant friction. Because of basic architectural limitations on human cognition real estate analysis is a heuristic process shadowed by predictable bias and haunted by sentiment.*

Furthermore, it has also been shown that reliance on heuristics increases with experience (Sah *et al*., 2010).

Tversky and Kahneman in their 1974 work *Judgement under uncertainty: Heuristics and biases* offered the idea that, in order to overcome an uncertain outcome in the future, decision-makers rely on heuristics or *rules of thumb* (Tversky & Kahneman, 1974, 1983). Within the feasibility analysis process, these rules of thumb are often applied to the values of future variables based on historic data or past experience Crosby *et al*., 2018a, p. 2). Often these rules of thumb are incorporated into 'go/no-go' hurdle rates (Hutchinson *et al.*, 2017). Havard (2014, p. 13) when commenting on UK property developers states "the normally accepted rules of thumb are for a 20 per cent profit margin on costs for speculative commercial schemes, and 10 to 15 per cent on residual projects." This research will investigate if these suggested hurdle rates are also applicable in Australia.

Hence, more specifically, this research aims to:

- To ascertain the level of heuristics prevalent within the real estate industry and how they handle uncertainty and risk.
- To examine the processes of risk definition at the preliminary feasibility stage and how these influences risk management during the project.
- To examine if there have been any significant changes in practice or heuristics used in the decision-making process as a result of the GFC.
- To investigate how the experience of experts influences and/or changes the usage and methods of both the use of heuristics and the decision process when compared to educated but relatively inexperienced novices.
- To trace the decision analysis process, comparing not only decision-makers with differing levels of experience but also between the various sectors within the real estate property market.

Research Aim 3:

Consider the use of Monte Carlo simulations, Bayesian models and option theory, real and embedded options in long-term property development and investment decision making as instruments for providing flexibility and managing risk, uncertainty and change.

Hence, more specifically:

- **RQ 7:** Do Australian property development companies use sophisticated theory-led structured quantitative analyses in the feasibility models used in the decision-making processes of the pre-commitment stages of the development process? Do Australian development firms use Monte Carlo simulations, Bayesian models, and/or option theory to aid decision-making?

- **RQ 8:** Are Australian property development companies confident in their organisation's risk identification and management practices in the decision-making processes of the pre-commitment stages of the development process?

This research also aims to investigate the use of real option theory, which is based upon the theoretical models of option theory that have been used in the derivatives markets since the founding of the Chicago Board Option Exchange (CBOE) in 1973. The Black Scholes and then the Black Scholes Merton model of valuing a derivative of an underlying asset given five key pieces of information uses:

1. Underlying price
2. Strike price
3. Time to expiration
4. Risk-free rate of return
5. Implied volatility of the underlying asset

(Black & Scholes, 1973; Merton 1976)

The subsequent addition of consistent revenue streams tied to the underlying Merton model allowed for regular dividends to form part of the valuation methodology.

Later option theory was applied to business management decision processes as a valuation methodology for a business or project. Real option theory has adapted the underlying option theory as a means of valuation of the potential for a project site or the flexibility of staging and or delaying commencement. Over the last decade there have been numerous publications along these lines, but most models proposed are very complex and problematic to use in daily practice. The practices used in industry versus the techniques described in the academic literature (known as the 'town/gown gap') is very wide in relation to the application of real option theory in preliminary feasibility analysis (Grenadier, 1996; Hengels, 2005; Bulan *et al*., 2009; Cunningham, 2006, 2007; De Neufville *et al*., (2006); Dong & Sing, 2017).

1.5 Research Structure

This thesis has been structured along the following basis, and is also illustrated in Figure 1.5:

Chapter 1: Introduction
This chapter provides an overview of the thesis topic as well as describing the research motivation, research methodology adopted, the research aims and specific research questions and the overall structure of the thesis.

Chapter 2: The Real Estate Development Process
In order to understand the decision-making processes of property development organisations, it is important to understand the property development industry and the property development process within which decisions are made. Chapter 2 provides an overview of the role of property development, types of

property development and the history and evolution of property development process models.

Chapter 3: Decision Making and Determining Viability

This chapter provides an overview of the literature from finance and related property fields regarding the determination of viability and feasibility analysis. Decision-making models, as well as methods for determining project viability, are reviewed. Additionally, the common aspects of feasibility analysis used in industry to determine viability are discussed as well as the literature regarding the selection and use of key hurdle rate financial metrics.

Chapter 4: Risk and Uncertainty in Property Development Decision Making

This chapter provides an overview of how risk and uncertainty are present in property development projects and outlines key literature concerning the identification, measurement and evaluation of risk. As this research is primarily concerned with the detection and management of potential risks at the pre-commitment stages of the development process, specific risk analysis methods commonly used in feasibility analysis are reviewed. Additionally, this chapter will provide a background to the evolution of the theory of the identification of risk and uncertainty. Finally, methods and strategies for risk transference by project development companies are also examined.

Chapter 5: Research Methods

This chapter reviews the research methodology adopted as well as identifies the key research questions. The research method used for this thesis a *parallel mixed method* design conducted through a single survey. This chapter discusses the sampling and data collection methods used as well as the statistical methods to be applied to analyse the data and address the research questions. Finally, consideration is given to the limitations of the research a consequence of the selection and application of the chosen research methodology.

Chapter 6: Results

This chapter analyses and discusses the results of the statistical analysis conducted on the data collected by the research instrument. Additionally, the specific research questions addressing each research aim are addressed and discussed.

Chapter 7: Recommendations and further research

This chapter provides a conclusion to the thesis and a summary of the findings from the data analysis. Additionally, this chapter presents the key recommendations and discusses the research contribution of the thesis and presents recommendations for future research. This chapter is followed by the thesis references and appendices.

1.6 Summary

Chapter 1 has provided an overview of the purpose and background of the study. Additionally, the research questions and research methodology were discussed as well as an outline of the structure of the thesis. The following chapter will discuss the literature regarding the role of property development in an urban environment as well as give an overview of the history and evolution of the real estate or property development process.

Figure 1.5 Research Structure

Source: Author (2018); derived from Cerimagic (2012)

Chapter 2: The Real Estate Development Process

2.1 Introduction

Chapter one provided a brief introduction outlining the research objectives and key areas of literature that will be reviewed as part of this thesis. The research questions themselves derive from activities that are found within the overall property development process. This process will be discussed from both the perspective of the historical evolution of the guiding principles as well as a modern practical application. The prevailing models and steps within the property development process will be covered in detail in this chapter. The property development industry in Australia will be discussed and the role of the property developer will be reviewed before moving on to the specific stages and decision-making processes involved in determining if a property development project should proceed.

2.2 Property development defined

The real estate development process categorically describes the sequences of steps within a project. Throughout this research, the terms property development (used primarily in Australia and the UK) and real estate development (used in the United States) are used interchangeably. Property development is widely accepted as the most important activity in the generation of the urban environment (Gillen & Fisher, 2002; Morgan , 2010).

Early attempts to define *property development* were task-oriented, as is outlined by the Pilcher Report (HMSO, 1975):

Development comprises the following tasks:

i. The perception and estimation of demand for new buildings of different types;
ii. The identification and securing of sites on which buildings might be constructed to meet that demand;
iii. The design of accommodation to meet the demand on the sites identified;
iv. The arrangement of short- and long-term finance to fund site acquisition and construction;
v. The management of design and construction; and
vi. The letting and management of the completed building.

(British Property Federation, *Policy for Land*, 1976)

James Graskamp (Graaskamp, 1981, p. 230) described property development as follows:

> *Being like a manufactured product, and a real estate project is part of a larger physical system programmed to achieve long-term objectives, but each real estate project is also a small business enterprise of its own.*

Byrne & Cadman (1984, p3) adopted a wider interpretation of the term to mean a process where property development organisations, corporately or on their own, aim to 'secure their social and economic objectives by the improvement of land and the construction or refurbishment of buildings for occupation by themselves or others'.

The development process is a methodology of project analysis and implementation. The Urban Land Institute (ULI) defines *real estate development* as follows:

> *The process of preparing raw land so that it becomes suitable for the erection of buildings; it generally involves clearing and grading land and installing roads and utility services.* (Miles *et al*., 2000, p. 3)

Additionally, real estate development can be described as a process that brings built space into fruition, starting with an idea and ending with tenants and owners occupying space (Miles *et al*., 2015). These definitions are utilitarian in nature and fall short of capturing fully the complex social, entrepreneurial and financial linkages involved in the activity. Property development has become an integral part of the fabric of modern society as the trend in nations is becoming increasingly more urban (ADB, 2014), and the majority of the world population (55%) is now urbanised (U.N. DESA, 2018). Australia and New Zealand are among the most urbanised (approaching 90%) nations on earth making the property development role highly important to the well-being of the population.

Wilkinson and Reed (2005, p3) offer a distinctly more Australian perspective by describing property development as a 'product of a change of land use and/or a new or altered building in a process that combines land, labour, materials and finance'. This definition reflects the high dependence on obtaining planning permissions in Australia for property development projects, by referring to the value that can be created through a change of a site's use.

A more recent perspective on property development was offered by Drane (2013, p2) as follows:

> *The particular state of transition or change in the form of real estate into a different state with an associated change in potential or real value. For*

> *example, the rezoning of land, development application, subdivision or construction of a title property et cetera.*

Drane (2013) also argued that property development is a value arbitrage in the transition of land from one use to another. Arbitrage value occurs when there is value to be obtained by the change of use or the completion of a development project on the potential site through the land planning mechanisms. When the value of the site is such that a change of use does not increase its value from the current use then the arbitrage ends. Kohlhepp and Kohlhepp (2018, p. 8) describe property development as the 'process of adding economic value to the real estate enterprise through various stages of development'. Drane (2013), Miles *et al.* (2015), Peiser & Frej (2003) and Wilkinson & Reed (2005) all refer to the entrepreneurial aspect of property development, describing the act of development as an idea that comes to fruition when consumers - tenants or occupants - acquire and use bricks and mortar put in place by the development team. Value is created by providing usable space over time with associated services. Real estate developers take the risk of the project in anticipation of receiving economic profit sufficient to justify risk-taking behaviour (Kohlhepp & Kohlhepp, 2018) Veteran property developer Clay Emery described property development as 'a very simple business. You find the opportunity, evaluate the risk and returns, and then arrange the financing' (Kohlhepp & Kohlhepp, 2018, p. 11).

For the purpose of this research, property development will be defined as a sequence of steps that take a property development project from inception through to construction and completion including the management of the asset over its lifecycle in order to derive value and achieve the objectives of the project.

This section gave an overview of property development and discussed its importance in an urban environment, and the next section will describe the many roles that the property developer must assume in order to be able to create successful projects.

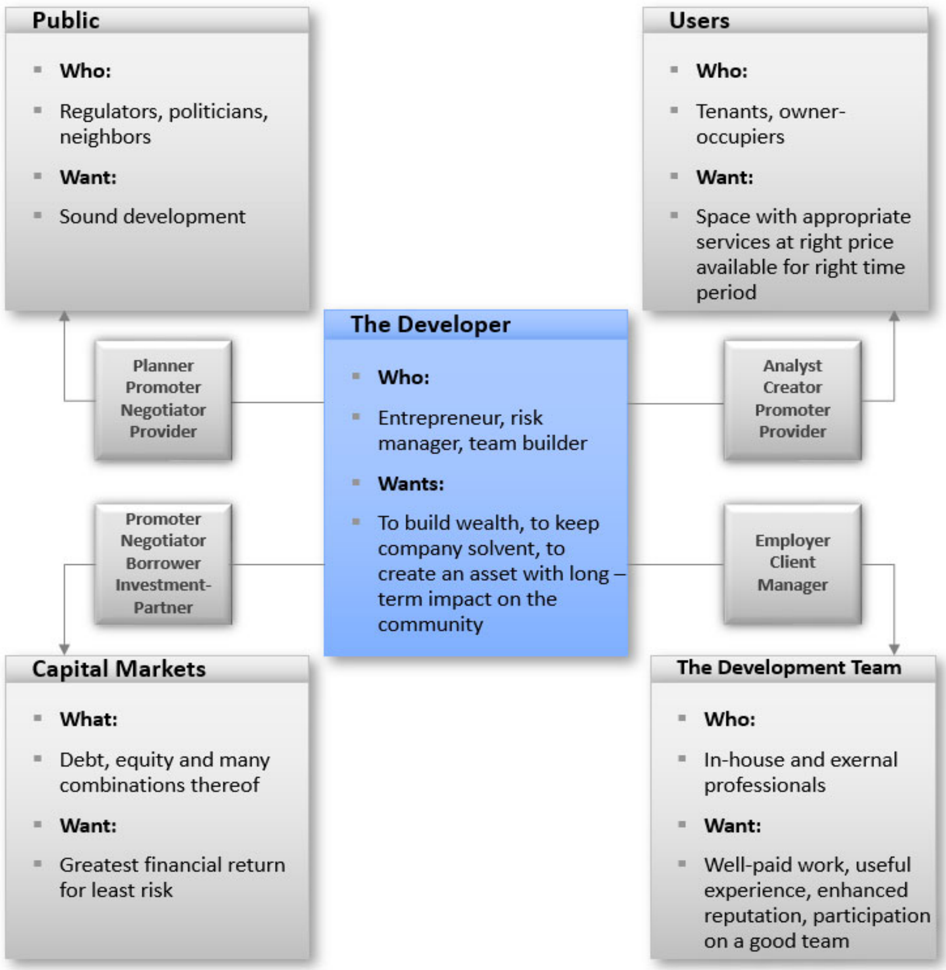
2.3 The role of the developer

The role of the property developer may be viewed as central to a process of public and private users, of capital markets and the development team with all participants offering and seeking varying – and often competing – inputs and outcomes. Figure 2.3 'The role of the developer' illustrates this in more detail with the relationship of the other stakeholders mediated through specified roles.

From the public perspective, property development occurs within a large and complex framework of the legislative process at the local council, state and Commonwealth levels. Local planning instruments and decision processes ultimately determine what is permissible for a potential project, but there are many concurring agencies at the state level including permissions regarding roads and access, environmental concerns and the registration of titles to name a few. Ultimately the public is seeking to maximise the benefit to society at large through sound development practices by the use of developmental control.

The property developer interacts with broader society who become the users of the end product in the form of owner's and tenants. Users are looking for affordable development that meets their needs. Additionally, property developers interact with the capital markets in the form of raising debt and equity to fund projects. Development projects and capital facilities have traditionally been highly geared as measured by the loan to cost ratio (LCR) due to the large amounts of capital required (Bryant, 2012). Providers of capital are seeking thoroughly researched investment opportunities with an attractive risk/return ratio based on analysed gained during due diligence. When capital providers tighten their lending requirements, this forms a key constraint on development and housing supply further exacerbating housing affordability issues (Bryant, 2012; Sharam *et al.*, 2015).

Figure 2.3: The Developer's many roles



Source: Miles & Berens, 2015, p. 9

The property developer also fills the role as project manager of an often large team of professional consultants who need to work toward a common goal in order to create and achieve the project's objectives. All these roles co-exist within an entrepreneurial framework that actively seeks to take a risk in order to create wealth and meet the financial goals of investors.

This section described the varying roles of the property developer in general common, and the following section will break down this role into developer types.

2.4 Types of property development

Property developers can range in form and scale from an entity run by a single individual (sole-trader) to large public companies and multi-national organisations (Reed & Sims, 2014). This wide range of activities can make it difficult to identify property development organisations and often the activity is context-dependent (Coiacetto, 2009). This wide spectrum of organisations creates challenges when attempting to place boundaries around the decision-making characteristics of various firms (Reed & Sims, 2014; Wilkinson & Reed, 2005).

The most common approach to creating a typology of property developers is the basis of the predominant property type that is created in their projects. It is generally accepted that property development organisations cannot be experts across the broad range of property types and will usually specialise in one or two product types (Kohlhepp & Kohlhepp, 2018). These can be broad-based such as residential and commercial, or more specific such as retirement living or childcare centres. The primary classification of developers is by property type including residential, commercial, industrial, retail, tourism/holiday, aged-care, land developer, infrastructure developer, institutional developer and mixed-use or a hybrid of the above types (Peiser & Frej, 2003; Peiser & Hamilton, 2012; Brueggerman & Fisher, 2015; Kohlhepp, 2012).

Just as there exists a variety of property types that property development organisations can undertake, there are a number of other characteristics that can be attributed to property development organisations in forming developer typologies (Isaac *et al*., 2016; Ratcliffe *et al*., 2009). An overarching definition describing the characteristics of property developers is difficult to establish, and therefore, it becomes necessary to create developer types based on the following attributes :

- The type of property developed
- Organisational/ownership structure
- The tenure of the developed product
- Geographic distribution and
- The overall objective of the property development project

These characteristics may have a direct impact on the decision-making processes and be contingent on the type of project outcome sought.

A review of the relevant literature concerning property developer typologies demonstrates a number of different bases being adopted for this classification. Rowley *et al.* (2014, p. 14) classified residential property developers based on the size of the end-value in dollars of the typical development projects which they undertake, which being:

- Low value – less than AUD 3 million - The majority of development organisations in Australia fall into this category

- Medium value – between AUD 3 million and AUD 20 million – small and medium scale projects are undertaken, and typically each project is treated on its own merits and must stand alone regarding viability;
- High value – above AUD 20 million – undertake large-scale projects and are often national or international in scale.
  (Rowley *et al.*, 2014, p. 14)

Ruming (2010) listed three generally accepted developer types in Sydney, Australia which included the following:

- Small Local – conducted by small local firms that stay within a defined area. This group is often family-based and generally can be referred to as 'mum-and-dad' developers
- Medium Local and Regional – operate on a larger scale but generally stay within a local area. They are better financed and undertake many medium density projects
- Large Regional – developers who often complete the large-scale greenfield development on city fringes. This type is often publicly listed, has access to large amounts of financial resources and is often national or international in scale
  (Ruming, 2010, p. 67)

Developers can also be classified as being a trader developer or a speculative developer (Morely, 2002; Reed & Sims, 2014; Wiegelmann, 2012; Wilkinson & Reed, 2005, Sharam *et al.*, 2015).

After reviewing the literature in the prior section, a number of classifications of developer typologies have been adopted and are described as follows:

2.4.1 Ownership structure – public, private or hybrid development

- Public – a government organisation tasked with a specific objective to create a property for a desired end-use.
- Private – privately held or a publicly listed company that exists for the purpose of deriving value for shareholders.
- Hybrid – a mixture of public and private ownership. Such companies will have a private legal structure, but with the majority shareholder being a government body. The company is often directed to undertake development to increase a specific type of property, but also has the objective of deriving an economic profit for the government shareholder and also to drive social outcomes. Examples of hybrid developers include Economic Development Queensland (EDQ) in Queensland, Lancorp in Western Australia, Landcorp in Western Australia and Urban Growth in New South Wales. The overarching purpose of these organisations is to facilitate government plans for urban growth and housing supply targets (Rowley *et al*., 2014).

2.4.2 Speculative trader versus investor developers

Most property development organisations can be described as either primarily speculative-trader or primarily investor orientated regarding the long-term tenure of the projects they create (Wilkinson & Reed, 2008). Due to capital budgeting and a limited resource pool of capital comprised of both equity and debt, many smaller property developers act as traders who sell the product they develop as they are not in a position to hold over the medium and long-term (Reed & Sims, 2014). There are primarily two areas where profits can be derived from real property assets, including capital gains and rental income (Rowland, 2010; Baum 2015). Rental income can be either cash-flow based or include imputed rent as an owner-occupier.

Speculative-trader developers initiate projects to make a profit via a capital gain from on-selling the completed property at a price higher than their cost base (Geltner *et al.*, 2007). Generally, these projects are of a shorter time horizon (less than three years) and do not cross multiple property cycles. Land-banking and large greenfield developments are an exception as these projects can span decades. Blocks of developed land are released in stages to the market and may span multiple cycles (Kohlehepp, 2012). Investor developers initiate projects in order to hold the completed property as an investment and derive rental income and long-term capital appreciation (Fisher, 1992). The development may become part of acquiring a larger portfolio of properties or for using the space as an owner-occupier. Rental income has an advantage over speculative capital-gains in reducing the volatility of income streams in the company's accounts (Baum, 2012). The reduced volatility leads to an altered risk outlook for a project and often would necessitate a different decision hurdle rate for project initiation (Ling & Archer, 2017). For this reason, many developers will have both speculative and investment motivations for completing a project, and they will be referred to as *hybrid developers* in this research. A common example of a hybrid development is creating a residential high-rise to sell as a speculative development while retaining the ground-floor retail space as an investment. The decision-making processes of trader and investor developers will be investigated in this research.

2.4.3 Development management versus traditional development

The above descriptions of speculative-trader and investment-focused developers are examples of traditional development where the organisation acquires land to conduct a property development project. *Development management* is where an individual or organisation that possesses knowledge of the development process acts as a project manager or consultant for a third party. This form of development is on a fee for service basis and also has a significantly reduced risk profile. Larger specialist management consultancy agencies often fill this role and focus on taking a project from the initial conception phases through to project planning (Wiegelmann, 2012). Development managers act as consultants and usually assume the operational risk but do not bear the major financial capital risk of the project, which is usually born by the client and/or land-owner as the primary contributor of equity and the borrower for the project (Gleibner & Wiegelmann, 2012).

2.4.4 Other categorical developer types

There exist other categories for developer typology that will be investigated further through this research as an empirical survey. As stated above, there are many motivations for undertaking property development and for engaging in viability studies including public organisations and semi-public/private developers who have varying objectives and constraints guiding their development activity. Additionally, other professions engage in viability studies and the determination of a development project's feasibility including property valuers, funds managers and financial lending institutions (Coleman *et al*., 2012).

2.5 The Property development industry in Australia

Property development is a very important part of both the Australian & New Zealand economies. The total development sector turnover is well over $100 billion annually in Australia and contributes between seven to nine per cent of GDP annually (ABS, 2016; Kelly, 2014), and the broader property market contributes approximately $209 billion AUD comprising thirteen per cent of Australia's GDP and employees 1.43 million people (PCA, 2017). Similarly, in New Zealand the property industry contributes approximately $30 billion NZD comprising 13% of New Zealand GDP and employees 161,000 people, making the property industry the fourth largest employer in New Zealand (NZPC, 2016).

The Australian Bureau of Statistics (ABS) defines development as including building construction, construction services, and property operators/real estate services. According to the ABS in February 2016 1.04 million Australians were employed in the development industry, including approximately 8.7 per cent of total employment (ABS, 2016). The Urban Development Institute of Australia (UDIA) describes the industry 'as a wide range of organisations and individuals involved in developing and operating property to meet the housing, employment and social needs of communities' (UDIA 2003, as cited by Newell 2006, p. 22). Residential property development accounts for 75 per cent of the Australian development gross output and large publicly listed property development companies account for approximately 10 per cent of the sector turnover, vastly different to public perception (Ernst & Young, 2002, 2003, 2014). This fact is even more surprising in Australia where traditionally oligopolies dominate many industries (Jenny, 2000; Coiacetto, 2009). The above section has described the categories and type of property development. The next section will discuss the historical and current evolution of the property development process.

2.6 The property development process

There exists a property development process that property developers follow that has been established in the literature. The historical concepts and evolution of this process will be discussed before examining the modern application of models that break away from the traditional sequencing of steps.

2.6.1 Historical concept and evolution of the development process

Property development companies engage in a development process to manage a property project over its life cycle (Wilkinson & Reed, 2005). A large number of theoretical development process models have been proposed and have evolved since the 1950s and involve the requirement of multi-dimensional decision making and include, but are not limited to, the following: Brueggeman & Fisher

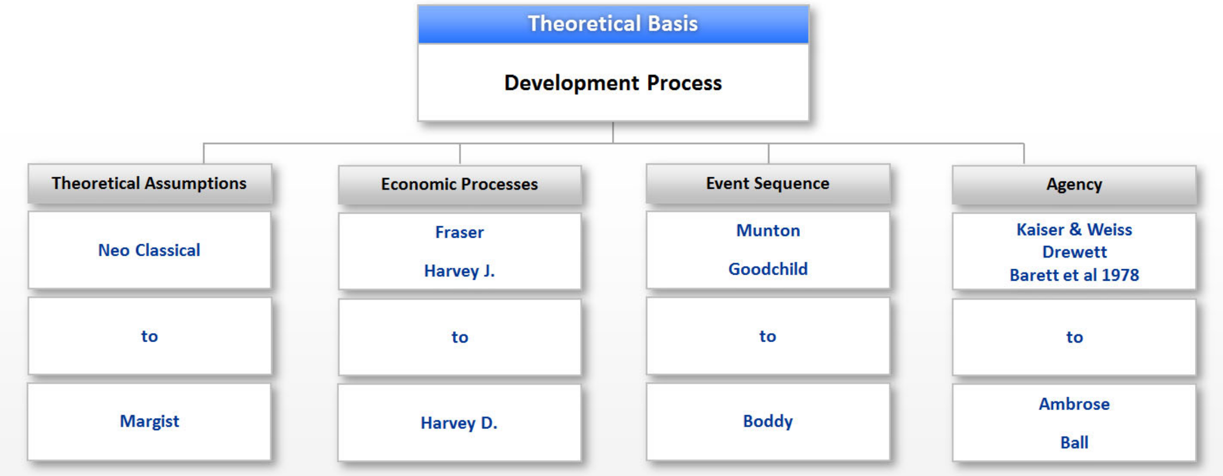
(2006, 2011); Cadman & Topping (1995); Isaac *et al.,* (2016); Kohlhepp (2012); Kohlhepp & Kohlhepp (2018); Long (2012); McMahan (2007); Miles *et al.,* (2008); Peca (2009); Peiser & Hamilton (2012); Preller & Costello (2010); Ratcliffe *et al.,* (2009); Sims & Reed (2015); Wilkinson & Reed (2008); Woodson (2005); Wurtzebach *et al.,* (1994); Zuckerman & Blevins (2003). A common link among these theoretical models includes the use of a sequence of steps that take a development project from conception through to construction and completion including the management of the asset over its life-cycle (Bulloch & Sullivan, 2010). However, in practice, to apply theoretical models in the industry, specifically the financial aspects and technical requirements of construction; Ball (1998) asserts that development models tend to fall within the four main traditions of property research including mainstream economics, power/behavioural approaches, structure-agency institutionalism and structure and provision theories. And more recently Drane (2013, p4) affirms this mismatch in the literature offering that the 'complexity and scope of such phenomena would render such models as individualistic and prospective, and limited by both a subjective/localised theoretical framework use'.

Notwithstanding the weaknesses and problems with existing models, the underlying principles and theories that seek to explain the development process have changed little over time and remain relevant today. Although many of the development process models appear to be very simple, the underlying development tasks are often rendered highly complex as a result of the increasing size and cost of projects which can occur over a considerable time horizon (Peiser & Frej, 2003). While easy to understand conceptually, development process models can lead to confusion, frustration, duplicity, and extraordinary risk-taking as the stakeholders in the process have either limited or minimal understanding of the process (Kohlhepp, 2012). Byrne (2002) observes all property development process models incorporate three main areas which are acquisition and permission, production and disposal. The first area of acquisition and permission which encompasses the decision to proceed with a project and make a site acquisition is the primary focus of this thesis.

Additionally, the end product of the property development process frequently possesses unique characteristics which further increase the complexity of this process (Havard & Platts, 2008). Graaskamp (1981, p.28) also described the development process, and each new potential project, as a creation of the political process where society is given a new opportunity to 'negotiate, debate and consider the basic issues of an enterprise economy'. This aspect of real property assets has led to the inclination to create a 'one size fits all' model which tends to be heavily weighted towards a simple residential project. Havard and Platts (2008) noted that the continuing trend towards city-centre living lends itself to breaking down barriers that have long existed between commercial and residential developers, and also advocates the splitting of residential from commercial sectors as well as categorising the commercial sector into developer/traders and developer/investors. *Developer/investors* often develop commercial, retail and/or industrial buildings which are then transferred into a special purpose vehicle (SPV) legal structure where the asset is securitised and managed over its life-cycle. An example of this practice is the modern creation of real estate investment trusts (REITs) by publicly listed property developers such as Mirvac, Stockland and Goodman Group.

Drane (2012 & 2013) undertook a very detailed and comprehensive theoretical evaluation of the evolution of the development process models from the 1950s to more recent times. Drane (2013, p5) defined a property development model as 'a model which creates a theoretical concept of property development practice that is able to be generalised'. Healey (1992) and Healey & McNamara (1988) are two important studies that have shaped research in this area and chronicled the evolution of this process, evaluating the theoretical foundations of the development process from 1954 to the early 1990s. Healy (1991) outlined the key early models and their theoretical bias from 1954 – 1993 describing the categories as theoretical assumptions, economic processes, event sequence and agency, as shown in Figure 2.6.

Figure 2.6: Key theoretical basis of development process models



Source: Healey, 1991

Drane (2012) analysed 103 articles and books relating to models of the development process and found 26 different development models published from 1954 to 1992. However, the absence of many books and articles from 1993 to 2012 draws attention to a transition of theoretical perspectives from neo-classical economics and Marxist views towards the political economy and institutional analysis (Drane, 2012). It should be noted that these studies did not include Miles and Wurtzebach (1994), Miles *et al.*, (2000) or Grasskamp (1991) whose work occurred during this period and offer views central to any discussion of the evolution of development process models. In more recent times there has been a resurgence of interest concerning the development process (Havard, 2014; Kohlhepp & Kohlhepp, 2018).

It is no coincidence that the largest advances in the theory dealing with the property development process and associated decision-making have followed periods of dramatic volatility and economic loss, largely caused by shocks to capital markets, property and credit cycles (Havard 2014). A significant difference, occurring during the late 1980s to the early the 1990s in the evolution of the theory of property development models, was an emphasis on social issues demonstrating an urban planning perspective.

The 1980's capital market crash and the subsequent global recession have been largely accredited to a lack of economic responsibility in both fiscal and monetary policy by governments and blatant speculation by financial institutions and the broader business sector (Kaminsky & Reinhart, 1999). The aftermath gave rise to a greater public consciousness that the needs of society must be considered alongside individual property rights. Coiocetto (2009, p.117) argued that these views are most probably presented because of the 'underlying assumptions, of such models are sometimes characterised by a certain naiveté in isolation from real-life human machinations and maneuvering'. Coiocetto (2009) further explains that it would seem that the simulations are not always wholly distinguished from reality in such models, and they deal with developer behaviour without actually examining how and why they behave in such a way. Kohlhepp (2012, p. 3) described the development process as 'a complex, time-consuming, capital-intensive, multi-disciplinary, externality-generating, public-private endeavour'.

In the case of the GFC, renewed interest in the development process is being led by practitioners and academics who are primarily interested in improving the accuracy of industry analysis, practices and the quantification and management of uncertainty and risk including the following studies: Adams *et al.*, 2012; Coiacetto, 2009; Costello & Preller, 2010; Drane, 2012, 2013; Havard, 2014; Kohlhepp, 2012; Kohlhepp & Kohlhepp 2018.

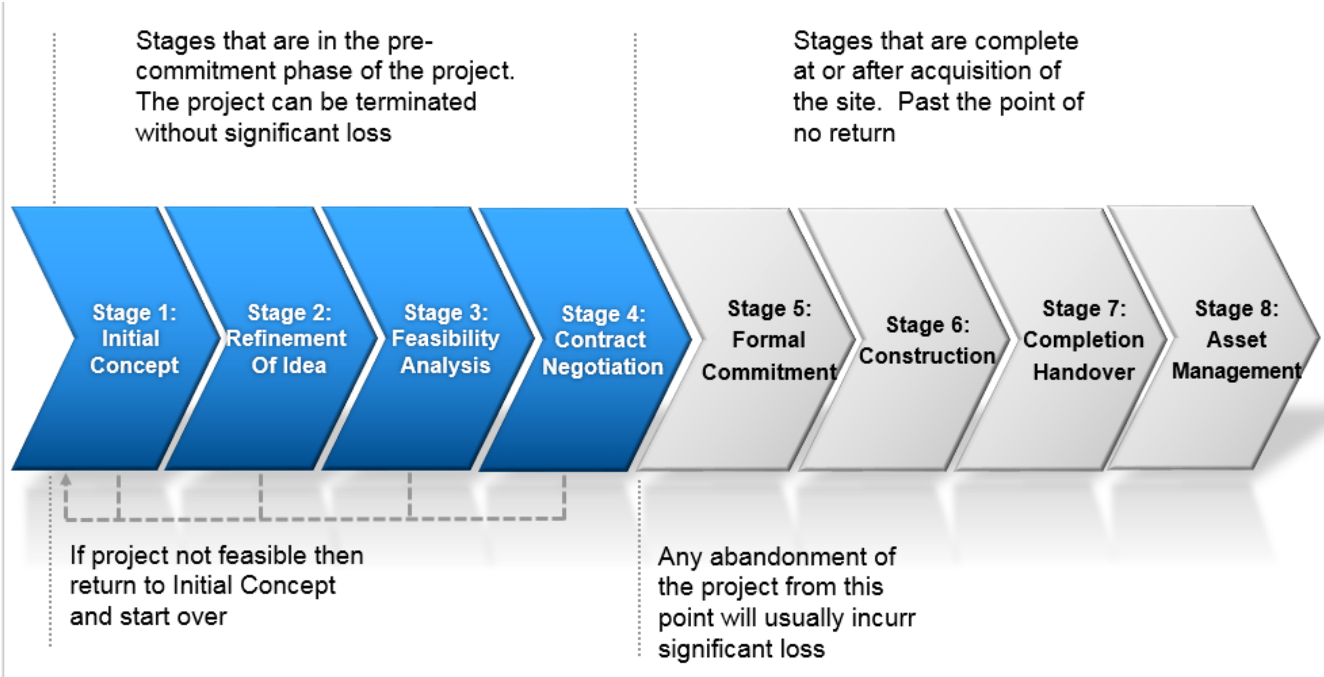
2.7 Urban Land Institute Development Process Model

As previously stated most proposed models follow a sequence of stages through the life-cycle from the initial concept of the project through to the management of the property. A popular model used in tertiary institutions to teach the principles of property development is the Urban Land Institute's Eight-Stage Model of Real Estate Development developed by Wurtzebach *et al.* 1994 as illustrated in Figure 2.7.1. For the purposes of this research, the first four stages of this model make up the pre-commitment stages of the property development process and form the research primary concern. The remaining four stages usually occur after the negotiation and formal legal commitment to acquire a property development site and form the first major requirement for large amounts of capital in the project. The pre-commitment stages of the development process are the most important, as decisions made early in the process usually have significant impacts on the overall project success or failure (Uher & Toakley, 1999). Also, it is in the pre-commitment stages of the development process where 'the greatest degree of uncertainty about the future is encountered' (Uher & Toakley, 1999, p. 161)

Stage I: inception of an idea

The development process typically begins with a developer searching for a need or a market gap to fill. From the utilisation of current market data and extensive background knowledge, many ideas will be generated. Various possibilities will be considered and market conditions are taken into account to undertake a preliminary feasibility analysis (Peiser & Frej, 2003). This can be seen as a brainstorming process where many ideas for a site or product are considered.

Figure 2.7.1: ULI Development Process Model



Adapted from Miles *et al*., 2015 and Miles *et al*., 1991, 2008

Developers at this stage will often complete a 'back of an envelope' pro forma feasibility as described by Miles *et al*. (2015). This process is a comparison of the value of output on completion of the production process less the cost of inputs. At this stage in the process, a more detailed financial analysis is not warranted as the development concept is not sufficiently developed and undertaking such analysis would be deemed time/cost-prohibitive. Often a simple ratio will be used such as a margin of value over estimated construction cost or a margin of value over rough anticipated costs. If the end value exceeds the cost of inputs by an acceptable margin, the idea survives, and, if the margin of value is not seen as acceptably high, then the concept is discarded (Byrne, 2002; Havard, 2014). Most ideas are found to be unacceptable at this stage of the process, with this step serving as a filtering process during which most ideas terminate with a 'no-go' decision.

Stage 2: Refinement of the Development Project

Ideas that survive an initial 'back of envelope' feasibility which has not been deemed a 'no-go' decision and show promising market potential are further examined in the refinement stage of the process. This stage generally includes the following activities:

- A more detailed scanning of the environment in relation to the shortlisted ideas,
- An analysis of competitors,
- An analysis of market comparables,
- Compiling a list of suitable sites,
- Examining a shortlist of possible market products,
- Investigate planning permissions to determine what can be built and included in initial design feasibility.

This stage of the development process may also involve:

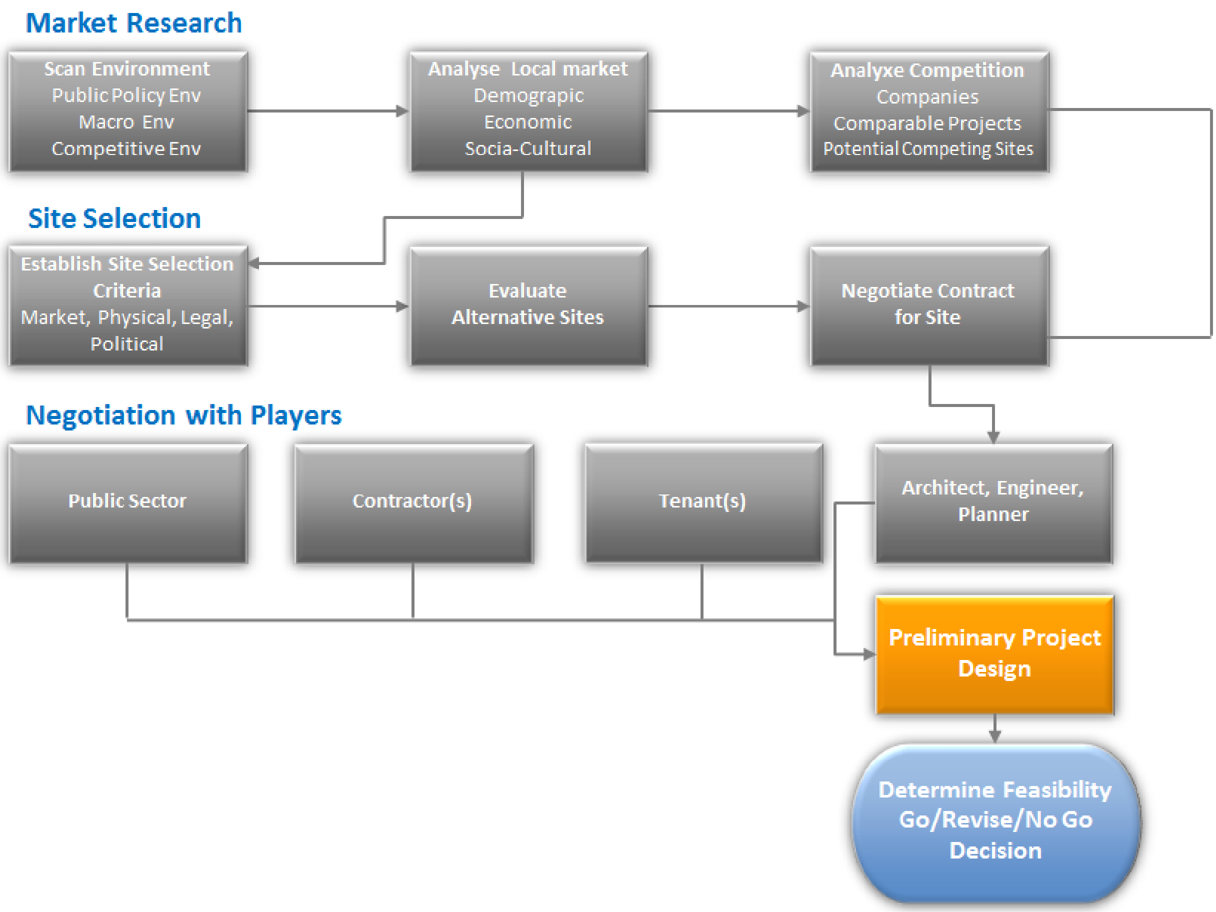
- Preliminary negotiations with vendors of potential sites.
- Completion of a market disaggregation and product differentiation concept.
- Continuing refinement of the financial feasibility by periodically retesting the back of the envelope numbers and preliminary projections of the timing of cash flows for the development period.

- Review financing criteria and investigate initial financing options.
- An initial risk identification and measurement exercise to test the design or project's preliminary feasibility discussions with professional advisors including engineers, architects, town planners, quantity surveyors, builders, real estate agents and possibly a preliminary meeting with financiers concerning a project's design and fit in the prospective tenant market (Miles *et al*., 2015).

Another key objective is the translation of all gathered information into a framework that highlights potential risks and rewards in relation to the developer's objectives. The concept of refining the idea may imply simplicity, but it is essential that the developer's ideas evolve towards a particular project design and on a specific site or the idea be will be abandoned before too many resources are expended on the project. 'Finding and acquiring a site and making an initial determination of legal and physical feasibility are the primary tasks in stage two' (Miles *et al*., 2008, p. 269).

In the refinement of the idea stage, the developer must be convinced of the project 's viability. It is necessary that the developer has a degree of confidence at this stage in order to make the commitment of resources that are now required. The number of potential projects or development options that can be analysed is endless. It is therefore important in the refinement of the idea stage to weed out those ideas that do not warrant expending time and capital in completing a full feasibility analysis in stage three of the development process. Feasibility analysis for a development project can take place in a time frame of weeks to months and range in cost from a few thousand dollars to millions of dollars. A development organisation will use the 'refinement of the idea' stage of the development process to select those ideas and development options which warrant expending their limited amount of capital (Peiser & Hamilton, 2012).

Figure 2.7.2: Step two-refinement of the Idea



Source: adapted from Miles *et al.*, 2000

Figure 2.4 adapted from Miles *et al.* (2000) outlines the activities involved in the 'refinement of the idea' stage of the development process and how they work towards a specific go/no-go decision point.

Stage 3: Feasibility Analysis

The primary task in the feasibility analysis stage of the development process is to demonstrate the viability of the project to all the vested stakeholders (Miles *et al*., 2008). This is done by producing a sound market analysis that culminates in a projection of net operating income for the subject development project over the relevant time frame. A *market analysis* is 'a process for examining the demand for and supply of a particular property type and the geographic market area for that property type. This process is generally referred to in industry as a 'use in search of a site' (Reed, 2015, p. 128). It is at this stage that the developer is required to commit additional capital to the project and perform a more detailed analysis utilising several dimensions. Additionally, the developer will experience the first 'hurt money' into the project. *Hurt money*, is an industry term for sunk costs, and includes capital that is then expended on a project that cannot be recouped unless the project proceeds. In the prior preliminary and refinement of the idea stages of the development process, only minor expenditure has been incurred on design and consultant's reports, which enables the project to be abandoned with little consequence. The feasibility analysis stage of the development process marks a transition between little serious investment at risk to a serious financial commitment.

Graaskamp (1972, p. 7) described a project as feasibility as follows:

> *A project being feasible when the real estate analyst determines that there is a reasonable likelihood of satisfying explicit objectives when a selected course of action is tested for fit to a context of specific constraints and limited resources.*

A *feasibility study* is an investigation into the practicability of a project. *Viability* is the determination that a development project is practicable from an economic standpoint (Bryne *et al*., 2011). The purpose of feasibility analysis is to determine that a project is viable financially and the risks have been mitigated to the point that a project should be undertaken, given the assumptions made on the input variables. Graaskamp also referred to a 'reasonable likelihood' as a demonstration of the high level of uncertainty that is, in many cases inherent in forecasting. The timeframe from the feasibility study to the completion of the project is, in many cases, over a number of years. A project with a highly profitable forecast may still end up losing money if there is a dramatic shift in the underlying assumptions (Coleman *et al*., 2012). Feasibility is also determined by satisfying other explicit objectives that must be defined before initiating the study. The selected course of action is tested for fit into a context of specific constraints, which include all the legal and physical limitations. It is not simply a question of whether or not an idea might work, but rather it is a question whether a particular plan for turning an idea into a physical building is likely to work within *a specific time frame given* while also satisfying all other project constraints (Miles *et al*., 2008).

A *development appraisal* is a report that includes a financial analysis and also contain additional elements including an executive summary, market study, preliminary drivers, cost estimates, information about financing, planning permissions, an estimate of value and an analysis of project risk (Havard, 2014; Miles *et al*., 2000; Peiser & Frej, 2003). The following critical and analytical issues should be considered when completing a feasibility study:

1. The idea and market for the project, from the concept down to a specific absorption schedule, then the particular market niche under current conditions:
    a. national, regional and local market outlook
    b. demographic attributes of the target market
    c. sales and rental comparables
    d. market segmentation including the identification of key marketability traits
    e. evaluation of existing supply, and known competing proposals

2. Compilation and analysis
    a. incorporate the assumptions into a discount cash flow model
    b. perform sensitivity and/or scenario analysis
    c. review risks and optimal configuration
    d. confirm that the project is feasible

A detailed feasibility study or development appraisal will then often be compiled into a report and ultimately make a recommendation as to whether the project should proceed or not given the specific financial metrics and hurdle rates chosen in order to make a decision. The use of the term *hurdle rates* implies that there is a minimum accepted profit or return that the development project is deemed likely to meet or exceed, given the level of risk implied within the project (Ross *et al.*, 2008). A hurdle rate can also be described as the minimum expected rate of return an investment must return in order to be considered attractive, or 'the risk-adjusted return must clear the required hurdle rate benchmark for further resources to be committed to the project' (Kierulff, 2008, p. 324). Hurdle rate selection and the application of feasibility analysis to the viability of specific development projects will be discussed further in Chapter 3.

The development appraisal report will compile the key information concerning the proposed project/site and generally will include the following items:

- Executive Summary
- Maps of the site including political and an aerial photograph
- Photographs of the site from the ground and street perspective
- Renderings of possible design solutions
- Market study outlining both area demographics, demand and supply attributes.
- Financial analysis of the proposed development options
- Monthly cashflow of proposed development options

- Development program or timeline outlining key milestones
- Recommendation regarding proposed development options
  (Miles *et al.*, 2007, p. 395)

Stages 4 and 5: Contract Negotiation and Formal Commitment

Throughout Stage 4, contracts are being developed to implement the decision to proceed; during Stage 5, the contracts are executed. In Stage 4 the developer will often seek a memorandum of understanding (MOU) or a contract subject to due diligence (DD) (Miles et al., 2015). The due diligence period allows for the completion of the Stage 3 feasibility analysis while removing the site from the market. A contract with a due diligence clause can be compared to having a call option over the site, giving the developer the right but not the obligation to purchase the site at a particular point in time and a particular price. A memorandum of understanding has a similar effect but, since formal contracts have not been agreed upon, it allows for the negotiation of terms to continue. In Stage 5 a formal commitment of an unconditional contract is entered into and the transfer of ownership of the site is settled (Isaac *et al.*, 2010).

It is at this point that the pre-commitment stages of the development process are at an end. If the project is found to be unfeasible at any point prior to the formal commitment then the project is terminated. If a formal commitment to proceed has been made then the development project has gone past the point of no return. If the project is later found to be unfeasible or if the project is abandoned from this point forward, significant costs will be incurred including acquisition costs plus initial design consultant costs. Any attempt to back out of the purchase of the site will incur damages and/or the vendor suing for specific performance (Havard, 2014). Byrne (2002) described this as one of the first major points of committing capital, which acts throughout the development process 'like a snowball' by accumulating interest.

Byrne (1996, 2002) demonstrated that all development process models could be divided into three parts which include acquisition, production and disposal. This distinction can be seen within publicly listed development companies using structural separation within their organisations of the three parts of the development process: acquisition, development management and asset management. In the pre-commitment stages, acquisition managers are responsible for the initial ideas, refinement of the ideas, feasibility analysis and contract negotiation up to the formal commitment. After a formal commitment has been made the project is handed over to a development manager who will then proceed through the permissions, construction, and handover to the client or possibly in-house asset management (Guy & Henneberry, 2002). This research is bounded by those decisions falling within the pre-commitment or acquisition stages of the development process, and the remaining stages are not analysed further.

Stage 6: Construction

Stage 6 of the ULI development process involves the physical preparation of the land through civil construction and, if required, the constructing of substructures and superstructures which form the object of the development project. The construction of the project is the first post-commitment stage of the development process, and abandoning the project from this point will have substantial financial consequences (Miles *et al.*, 2008). This stage differs from the previous stages in that the effect of time compounds on multiple uncertainties which may have a crucial impact on the financial outcome of the project (Byrne, 2002). Any cost increase will have a compounding negative effect, due to the interest cost of debt capital, on the project's profitability as the time value of money takes effect. Additionally, the developer's understanding of the project composition begins to increase while the uncertainty regarding the outcomes of the project increases. During this stage the flexibility for change within the project is reduced, limiting the opportunity to respond to any changes in market forces.

The highest area of uncertainty during the construction stage concerns the cost of construction and possible cost blowouts due to unforeseen problems project (Byrne, 2002). This stage also marks the second major phase of capital commitment, after site acquisition, and often constitutes 50 – 80 per cent of the total development cost (TDC). Another important factor for consideration at this stage is the procurement method chosen for construction (Havard, 2014). A further important consideration is whether the developer is also the construction contractor. Many development organisations are also construction contractors, and many construction organisations will engage in property development, but it should be noted that they serve different roles. It is generally recognised that if the development project is only feasible after adding in the construction profit, then the project should not proceed. 'Many projects undertaken by developers to keep their contracting arms busy have led those developers to bankruptcy' (Peiser & Hamilton, 2012, p. 219). The rationale behind this view derives from when the developer organisation is also the construction contractor leading to the absorption of the construction risk as well as the development risk. Developing organisations are often willing to take on this added risk as they perceive the benefits of greater control and flexibility in the construction process and the possibility of lower construction costs to be worthwhile. It should be noted that many development project financiers require an independent construction contractor whereby the financier can take control of the construction contract via an agreement in case of default by the developer (Hedgcock & Lynn, 2012). In an Australian context, the agreement is generally referred to as a tri-partite agreement and is routinely required by commercial lenders. Procurement methods which including tendering for a fixed price contract and 'design and construct' methods give greater certainty and reduce the overall risk of the development project (Azhar, 2011).

Stage 7: Completion and Formal Opening

After the construction is complete the developer will need to obtain the relevant authority certification in order to allow for occupation. For example, in Queensland this process includes certification of occupation, sealing of the plans and certification of titles in order to be allowed to occupy or settle the new property. Many planning authorities require inspections to ascertain that the civil construction and newly constructed buildings meet the relevant building codes, the approved development approval and are generally safe for members of the public to use. In many development projects it is also a requirement that concurring agencies sign off on the completed project these may include the following:

1. Obtaining Fire Authority sign off.
2. Lodging applications for easements required for services and site access for neighbouring properties.
3. Sealing of the plans by the relevant local council.
4. Environmental Planning Authority signing off on any relevant development approval conditions as a concurring agency.
5. Department of Main Roads signing off on any relevant development approval conditions as a concurring agency.
6. Lodgement of an application for registration of titles with the relevant state's authority. Department of Natural Resources, Mines and Energy (DRNME) in Queensland for example.
7. Setting up of the body corporate or community management.
8. Other lesser approvals from state or council-based authorities.

Other activities in this stage include education of key personnel, connecting services, commencing on-site operations, finalisation of the project marketing, formal handover, and the re-financing from a construction debt facility to a traditional commercial lending facility collectively constitutes stage 7 (Miles *et al*., 2008).

Stage 8: Property, Asset, and Portfolio Management

Stage 8 is primarily concerned with managing the newly created property asset over its life-cycle. The formal development process then ends with the handover of the new buildings/project in Stage 7. When the asset is sold and a property manager and/or owner assumes responsibility for the asset, the developer often has no further involvement in the project. This process raises an important aspect of development project decision-making (Ratcliffe *et al*., 2009). Do property developers view the development process as ending upon selling and handover of the asset? If so, will they create a project that addresses the many long-term considerations and needs of the building's life-cycle? Areas of concern include energy efficiency, alternative use, upkeep of landscaping and general maintenance (Häkkinen & Belloni, 2011).

The property development process invariably results in an idea or concept being transformed into a new physical asset. Once the construction is completed and the project formally handed over then the responsibility for that project will often end up the responsibility of the management components which includes property management, asset managers and portfolio managers (Miles *et al*., 2015).

The property management team is then responsible for the realisation of the investment potential, imputed value to the owner and the physical asset condition to allow the long-term value of the asset to be realised. *Property management* is concerned with managing the day-to-day operation of the asset including letting to tenants if needed and collection of rent and payment of property expenses (Peiser & Frej, 2003). The property manager executes the tactical objectives of the assets strategic plan as determined by the asset manager (Peiser & Frej, 2003). Across all types of property investments, including residential, commercial office, retail and industrial, larger properties will often have a dedicated property manager on site. Smaller property assets often will be aggregated and share a property management team.

The asset manager is often a step higher within the management hierarchy and is concerned with a number of property assets within a property portfolio. ‘Asset management monitors performance of property management and provides clear guidance to allow the teams to develop strategic plans that will maximize (sic) the asset’s values in the context of portfolio management’s objectives and capital resources and the constraints presented by market conditions’ (Miles *et al*., 2008, p. 507). The asset manager is responsible for determining and executing the strategic plan of the property assets within a portfolio. Asset managers are also responsible for fulfilling the owner/investors objectives of maximising the profit of the asset (Miles *et al*., 2007). Additionally, it is essential to have an awareness of the market and the property cycle to judge the optimal times for acquisition or refurbishment, holding period and disposal of the asset.

2.8 Recent development process model perspectives

A very important step in the evolution of the theory of the real estate development process includes the Kohlhepp and Kohlhepp’s (2018) Real Estate Development Matrix Model. First introduced in a working paper in 2012 (Kohlhepp, 2012) a textbook further developing this model was published in

2018. This section gives an overview of the unique contribution of the Real Estate Development Matrix model to the theory concerning property development.

Building on the work of Graaskamp (Graaskamp, 1981, 1992), Miles, Berens & Weiss (1991, 1996, 1999) and Miles *et al.* (2007, 2015) describing a mainly linear form of the property development process, Kohlhepp and Kohlhepp's Real Estate Development Matrix (REDM) adds the elements of property development tasks and property development types in a three dimensional matrix. 'It is a combination of the seven stages of the real estate development process across the horizontal axis with the eight task categories of development on the vertical axis, thus creating the 56-cell matrix' (Kohlhepp & Kohlhepp, 2018, p. 12). Table 2.8 outlines a two-dimensional matrix table showing development stages and key development tasks.

The REDM model of the real estate development process focusses on the possible exit strategies that exist within a typical project and requires a decision at each stage on whether to proceed or sell the project. At each progressive stage, the following conditions are likely to occur:

- Risk and uncertainty diminish;
- Additional capital is required;
- Additional capital has a lower cost;
- Value is created by producing a new product;
- Value is created by incurring additional risks and increasing capital exposure (Kohlhepp & Kohlhepp, 2018, p.12).

It is anticipated that the above conditions would be accepted by professionals working within the property development industry in Australia, though beyond the scope of this thesis, this is an area for further research. Many property developers will focus the majority of their projects within specific stages of the process such as land banking (Kohlhepp, 2012). Land banking can be defined as "the process of acquiring and holding undeveloped or "raw" land that becomes increasingly attractive for future development because of general and broad market trends" (Kohlhepp & Kohlhepp, 2018, p 24).

Table 2.8 Two-Dimensional Real Estate Development Matrix (REDM)

Development Matrix	1. Land Banking	2. Land Packaging	3. Land Development	4. Building Development	5. Building Operations	6.Building Renovations	7. Property Re-development
I. Acquisition	I. 1.	I. 2.	I. 3.	I. 4.	I. 5.	I. 6.	I. 7.
II. Financing	II. 1.	II. 2.	II. 3.	II. 4.	II. 5.	II. 6.	II. 7.
III. Market Analysis & Strategies	III. 1.	III. 2.	III. 3.	III. 4.	III. 5.	III. 6.	III. 7.
IV. Environmental Analysis	IV. 1.	IV. 2.	IV. 3.	IV. 4.	IV. 5.	IV. 6.	IV. 7.
V. Approvals & Permits	V. 1.	V. 2.	V. 3.	V. 4.	V. 5.	V. 6.	V. 7.
VI. Physical Improvements	VI. 1.	VI. 2.	VI. 3.	VI. 4.	VI. 5.	VI. 6.	VI. 7.
VII. Transportation/Accessibility	VII. 1.	VII. 2.	VII. 3.	VII. 4.	VII. 5.	VII. 6.	VII. 7.
VIII. Sales & Disposition	VIII. 1.	VIII. 2.	VIII. 3.	VIII. 4.	VIII. 5.	VIII. 6.	VIII. 7.

Source: Kohlhepp & Kohlhepp, 2018, p.12

Kohlhepp & Kohlhepp (2018) also outline three questions that a developer must answer at each stage before advancing to the next and include the following:

> *Can we do what has to be done in the next stage? Do we have the skills, resources, time, team, support and market knowledge? Can we handle the risk of failure?* (Kohlhepp & Kohlhepp, 2018, p. 13)

If the property developer is not able to answer 'yes' to each of the above questions in sequence, then the possibility of disposal of the project to a developer who has the resources, expertise and ability to advance the project should be considered.

2.10 Summary

Within the framework of this research thesis, the current chapter outlined and described a number of development process models that illustrate the process used by real estate development firms in order to bring a development project from initial concept and obtaining permissions through to completion, handover and the managing of the asset over its lifecycle. Additionally, property developer typologies were identified and defined; types of property development projects commonly undertaken were outlined; an overview of the Australian property development industry given; and finally, an original definition of property development was provided. The next chapter will focus on examining the feasibility analysis stage of the development process and review how developers make decisions on whether to proceed or not proceed with a development project.

Chapter 3: Decision Making and Determining Viability in Development Projects

3.1 Introduction

Chapter 2 provided an overview of the recent history and evolution of the property development process. The present chapter will be devoted to an examination of the literature concerning feasibility analysis and the decision-making processes used in property development projects, both conceptually and as a practical tool of analysis. More specifically, the techniques and decision tools involved in the pre-commitment stages of property development projects will be emphasised.

3.2 Feasibility analysis in the development process

The term *feasibility analysis* is often used in the real estate development industry generically to describe a report analysing the viability of a development project which can be more accurately described as a *development appraisal* (Havard, 2014, p. 12). It should also be understood that feasibility analysis may not always be in the form of a written report and many property developers take a more informal approach. A market study and a financial feasibility study together form the basis of a feasibility analysis for a given project. In this thesis, the terms feasibility analysis and development appraisal will be used interchangeably and both refer to the process of completing a financial feasibility study as a basis for decision-making on whether to proceed with a property development project. Ultimately, a feasibility analysis is concerned with making a determination of a development project's viability (Havard, 2014, p. 12). Throughout this thesis, the term *project viability* refers to the outcome of a feasibility analysis forecasting whether a potential development project is anticipated to meet or exceed the required hurdle rates, and therefore, warrants further investigation (Havard, 2014). It should also be noted that project feasibility is a common term that is used in the literature with the same meaning at project viability. (See Grasskamp (1991) for example).

As stated in Chapter 2, a market analysis is a ‘process where the demand for and supply of a particular property type is examined in a geographic market area’ (Reed, 2015, p. 128). This process is sometimes referred to as a ‘use in search of a site’ (Miles *et al*., 2015). Whereas a *marketability analysis* can be described as a process where the analyst ‘investigates how a particular piece of property will be absorbed, sold, or leased under current or anticipated market conditions’ (Reed, 2015, p. 128).

According to Kolbe *et al.* (2013), when considering a potential development project, ‘the study addresses the question of whether the relationship between development costs and market acceptance will enable the developer to meet minimum acceptable investment targets’ (Kolbe *et al*., 2013, p. 358). Technically, the feasibility analysis section incorporates a financial analysis of variables to determine if a project meets the required economic hurdle rates, as well as an examination of risk for that project. A development appraisal encompasses far more than a financial feasibility analysis and also requires compiling information across many market considerations including site characteristics, market analysis, planning schemes, design elements, legal challenges, cost variables, income forecasting, project timelines and risk management principles including mitigating strategies (Miles *et al*., 2015).

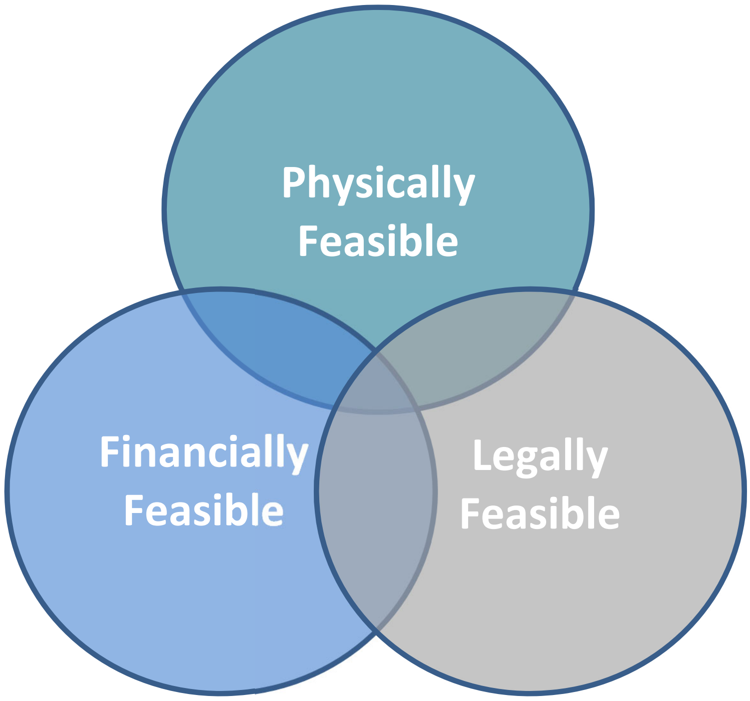
At this point, it is important to distinguish between the many terms used generically in the industry for feasibility analysis and development appraisal. A development appraisal carried out on a potential development project is concerned with finding the value of the finished property asset and the *highest and best use*, which is the use that represents the greatest economic financial value (Messner, 1977). By the very nature of the definition, the practice has been created by the valuation profession out of the need to find a project's value or worth as a requirement of obtaining funding. Kolbe *et al.* (2013, p. 358) described the valuer's or appraiser's perspective as the following:

> *Identifying a set of alternatives thought to be nominally feasible: uses that offer of a reasonable probability of meeting prevailing financial performance standards. From this set of feasible alternatives, the analyst seeks to identify one specific use that supports the greatest value indication for the property (the highest and best use).*

The term *feasibility analysis*, more often than not, refers to the perspective of the one planning to undertake the potential project, i.e. the developer or investor. The process is similar, but each profession will approach the process from the perspective of the key question they are seeking to answer. To the valuer, the question is what the property is worth now and what is it worth upon completion. For the property developer it is will this potential project be profitable, and if so by how much and is it worth pursuing? Regardless of the professional perspective for which a project is approached, in order for a project to be deemed feasible, there exists the necessity to be feasible physically, legally and financially as shown in Figure 3.2 (Kolbe *et al*., 2013).

The ultimate result of the analysis should not just be the finding of a project being merely feasible, nor that its end value exceeds the cost by the required metric, but the process of conducting the analysis should add value to the project (Graaskamp, 1970). The analysis should be considered as an optimisation tool for fine-tuning the development scheme to deliver a superior outcome (Miles *et al.*, 2008; Miles *et al.*, 2015; Wurtzebach *et al.*, 1994).

Figure 3.2: Dimensions of project viability



Source: Kolbe *et al.* (2013)

Havard (2014) illustrated a number of major uses for the development appraisal from the perspective of the property developer. The primary task in the feasibility analysis stage of the real estate development process is to demonstrate the viability of the project to all the vested stakeholders. The analysis of viability may also result in the calculation of the maximum bid-price for a given development site. Other major uses as described in Havard (2014, p. 12) includes:

> *Determination of a potential development scheme's forecasted profit or loss in order to determine viability, the impact of a range of variations on a project, to test the veracity of the assumptions, as a measurement of risk, and as a tool for raising capital in both debt and equity forms.*

A development appraisal is created by producing a sound market analysis that culminates in a projection of net operating income for the subject property over a specific time-frame (Phyrr & Cooper, 1982). It is at this stage that the property developer is required to commit additional capital to the project and perform a detailed analysis examining the specific timing of expenditure and revenue as well as key debt and equity contributions. Additionally, the developer will experience the first 'hurt money' involved in the project. *Hurt money* is capital expended on a project that cannot be recouped unless the project proceeds. In the prior preliminary stages of the development process, only minor expenditure has been incurred on design and consultants' reports, which enables the project to be abandoned with little consequence (Kahr & Thomsett, 2006).

3.3 History and evolution

Feasibility analysis for property investment/development-based projects first began to take its modern shape through the evolution of cost-benefit analysis (CBA) being applied to the Urban Renewal movement of the 1960s in the USA and UK (Baldwin, 1968; Messner, 1966, 1968; Prest & Turvey, 1965). The principles of CBA were also alluded to in deciding between a 'moral or prudential algebra' in Benjamin Franklin's letters to Joseph Preistley, who was an English political theorist and minister, in 1772 and just prior to the decision to declare independence for the American colonies (Franklin, 1887). CBA was more formally developed by Jules Dupuit and officially published by Alfred Marshall in 1848 (Wiener, 2013). Cost-benefit analysis can be defined as a systematic approach to 'estimating the strengths and weaknesses of alternatives, and it is used to determine options that provide the best approach to achieve benefits while preserving savings' (Mishan & Quah, 2007, p. 5). Modern-day feasibility analysis has partially evolved from this analytical body of work, although it has been adapted to determine the highest achieving development scheme among a number of development options (Pagourtzi *et al*., 2003).

The application of modern quantitative feasibility analysis to development projects, including the use of DCF methodologies in the pre-commitment stages of the development process, was advanced by James Graaskamp, who described project feasibility or viability as follows:

> *Being feasible when the real estate analyst determines that there is a reasonable likelihood of satisfying explicit objectives when a selected course of action is tested for fit to a context of specific constraints and limited resources.* (Graaskamp, 1972, p. 7)

The purpose of the feasibility analysis is to determine that a project is feasible financially and the risks have been mitigated to the point that a project should be undertaken (Graaskamp, 1981). Graaskamp also referred to a *reasonable likelihood* as a demonstration of the high level of uncertainty that is, in many cases, inherent in forecasting. The timeframe from the feasibility study to the completion of the project is in many cases completed over several years (Graaskamp, 1991, 1992). A project with a high degree of forecasted profit may still end up losing money if there is a dramatic shift in the underlying assumptions from which the forecast was made (Coleman *et al*., 2012). Therefore, a project that has been deemed feasible does not give certainty as to the outcome but is reflective of a reasonable weighing of the most probable outcome given the assumptions of input variables. Additionally, for a project to be considered feasible, it must be feasible within the limits of the resources, both in terms of financial and human capital, that a development organisation is willing or able to commit within a given timeframe (Peiser & Frej, 2003).

Feasibility is also determined by satisfying explicit objectives that must be defined before initiating the study (Geltner *et al.*, 2007). The selected course of action is tested for fit into a context of specific constraints, which include all the legal and physical limitations. It is not simply a question of whether or not an idea might work, but rather it is a question whether a particular plan for turning an idea into a physical asset is likely to work within a specific time frame (Miles *et al.*, 2015). The primary objective of undertaking feasibility analysis on a given project is to answer the question, 'Will the development scheme work?' or 'Is the development scheme likely to meet the development objectives?', and determine the degree of confidence the property developer has in going forward (Kolbe *et al.*, 2013).

3.4 Decision making for property development projects

At this point, it is advantageous to review the decision-making processes involved in the property development process before further investigating the mechanics of conducting a feasibility study. *Decision theory* is the 'study of how people model 'judgement' and, from that, how they determine their choice' (Atherton *et al.*, 2008, p. 164). These may be probability-based models, loss function models or other forms of statistical representations of judgements (French, 1986). Decision-making within the concept of property development bears similarity to the literature on decision-making for investment purposes whereby the investor commits resources in anticipation of receiving future income streams (Bazerman & Moore, 2008). From a property-specific context, decision theory is an attempt to provide a framework by which investors are able to make a decision that maximises their wealth (Hargitay & Yu, 1993, 2003; Paul *et al*., 2000).

Though there is evidence that many decision-makers in the property development industry do not strictly follow models based on observations in industry practice, it is important to understand the theoretical basis for decision-making models (Crosby *et al*., 2018b). A review of the literature has found that firms often divert away from a theoretical established model to make decisions in another manner (Atherton *et al*., 2008; Arnold & Hatzopoulos, 2000; Geltner, 2007; Baldwin and Clark, 1994; Investment Property Forum, 2017). In their pioneering work on decision models Tversky, Bell and Raiffa (1988) described three primary decision-making interactions which can be classified as descriptive, normative and prescriptive. Atherton *et al*. (2008) described their application in a property development context below:

1. Descriptive analysis: models which purport to describe how we do decide. Descriptive models do not seek to aid people in making 'rational' decisions.
2. Normative analysis: models which suggest how we should decide. 'Usually based on mathematical axioms, which define rational behaviour'. 'The decision-maker believes A and b then should do X and Y. However, the additional element that is critical in the development process is time'. (Atherton & French, 1997, p. 136; Bell *et al*., 1988)
3. 'Prescriptive analysis: models which use normative models to guide the decision-maker within other limiting cognitive parameters' (Atherton *et al*., 2008, p. 165).

From these descriptions, it can be ascertained, that a feasibility analysis is a rational normative approach. A descriptive model does not aim to make rational decisions and does not look to reduce bias in the choices made as a normative model would do. If the analyst believes in the likelihood that the input assumptions will be accurate, then they should choose those projects that pass their pre-determined project hurdles and benchmarks (Atherton *et al.,* 2008). Most earlier literature (circa 1980s to 2000) regarding decision-making in property investment and/or development projects focused on a set of rules which were often based on mathematical models to guide the decision-maker on the correct decision to be made. Key research such as Anderson and Settle (1996), Farragher and Kleiman (1996), Graaskamp (1992), Roberts and Henneberry (2007), Sharkawy (1994), Wurtzebach *et al*. (1994) and Miles (1989) demonstrated that this was often the case as part of setting the early foundations of applied normative models in the appraisal or assessment method.

However, in some situations, a developer may decide not to proceed with a project in which a normative model deems feasible, as they are concerned with the possibility of the assumed input variables turning out to be incorrect in the future, or there exists an alternative rationale for completing the subject project. But it is fair to say that normative models do influence decision making. Adair *et al.* (1994) found that decisions concerning property investment projects did proceed more often in areas where the input variables were more likely known and where uncertainty was reduced. French (1986) and Atherton *et al*. (2008) found that in Europe developers' and/or investors' behaviour often did not line up with the normative models applied. It is likely that this pattern of decision making will hold true with Australian property developers' decision-making processes. This research will further investigate this aspect in the decision to proceed with a project beyond the pre-commitment stages of the development process that will be outlined in in the research questions in Chapter 5.

Prescriptive decision models 'seek to guide decision-makers toward consistent rational choices while recognising their cognitive limits' (Bell *et al*., 1988, p. 17). Additionally, this type of decision model utilises descriptive theories of how decision-makers *do* make decisions in order to comprehend how cognitive processes are used, while also using 'normative theories of decision making as the ideal way to make decisions' (Bell *et al*., 1988, p. 17). Prescriptive theories try to guide the decision-maker in making the best possible rational choice. It is logical to assume that the evolution of feasibility analysis within the framework of a development appraisal has been moving from a normative model approach to a more prescriptive model. One explanation for this change is the lessons from the global financial crisis, as discussed in Chapter 2, and the levels of input uncertainty are better understood. In relation to prescriptive models and determining a projects financial viability it has been noted by McAllister (2017) that the very nature of financial viability appraisals are inherently uncertain and there are clear incentives for property developers to bias calculations to clear the minimum hurdle metric. This research will aim to gain an understanding of how feasibility analysis, particularly fixed-hurdle rates, are incorporated into the decision process to proceed beyond the pre-commitment stages of the property development process. This section detailed the foundational basis of decision processes in property development projects and the following section will review the concepts of bounded rationality and the behaviourist approach in decision making in the development process.

3.4.1 Bounded rationality and behavioural aspects of decision making in the development process

When reviewing the literature, it can also be noted that there have been a number of studies focused upon the behavioural aspects of decision-makers and specifically if *bounded rationality* and heuristic bias is present in the decision process. Particularly, in regard to the valuation of property assets and development projects research such as Diaz (1990a, 1990b, 1997, 2010); Diaz III (1990, 2010); Fainstein (1994, 2001); Gallimore (1994, 1996); Gallimore *et al*. (2000); Goldberg (1978); Busenitz & Barney (1997); Paul *et al*. (2000); Robinson & Robinson (1986); Diaz & Hansz (1997); Gallimore & Wolverton (1997); and Diaz & Wolverton (1998); Tan *et al*., (2016). These studies are among those that aimed at examining the overall impact of the behaviourists' approach to decision-making in property feasibility analysis and have made a valuable contribution to the more normative models that had been put forth in prior decades. The behaviourists' view can be described in that the decision-makers in organisations are human and, as such, are guided by human behaviour. Research shows that development managers have a high level of autonomy in development firms when deciding whether to proceed and are not bound by purely normative models (Hutchison *et al*., 2017; Crosby *et al*., 2018a & 2018b; Weigelmann, 2012; Fanstein, 1994, 2001; Whitehead, 1987). This research will aim to gain an insight into this process as well as to the existence of heuristic normative approaches in Australian development firms' decision-making processes.

3.4.2 Feasibility analysis and the decision to proceed

The property developer 'needs to question the assumptions that underpin the analysis which form the key indicators of uncertainty pertaining to a given project' (French & Loizou, 2012, p. 198). Uncertainty, risk and instability are common characteristics of property development and are an integral part of a development appraisal (Campbell, 1993; Coiacetto, 2009). The difference between risk and uncertainty will be explored in greater detail in Chapter 4, but the main difference is that *risk* is the potential occurrence of a future event that may produce an outcome different from that anticipated and that the outcome can be measured, whereas *uncertainty* deals with an outcome that is either unknown or cannot be measured (Regan, 2010; Langlois & Cosgel, 1976).

Therefore, it is important to 'know which variables give rise to the largest effect on a change of outcome, thus, where the risk is the highest' (French & Loizou, 2012, p. 198). This analysis creates the opportunity to attempt to decrease the risks that are viewed as too high. This process is, in large part, subjective and is subject to the current risk appetite of the decision-maker and their desire to maximise utility at the time of site acquisition (Camerer, 1998; Kahneman *et al*., 1997; Von Neumann & Morgenstern, 2007).

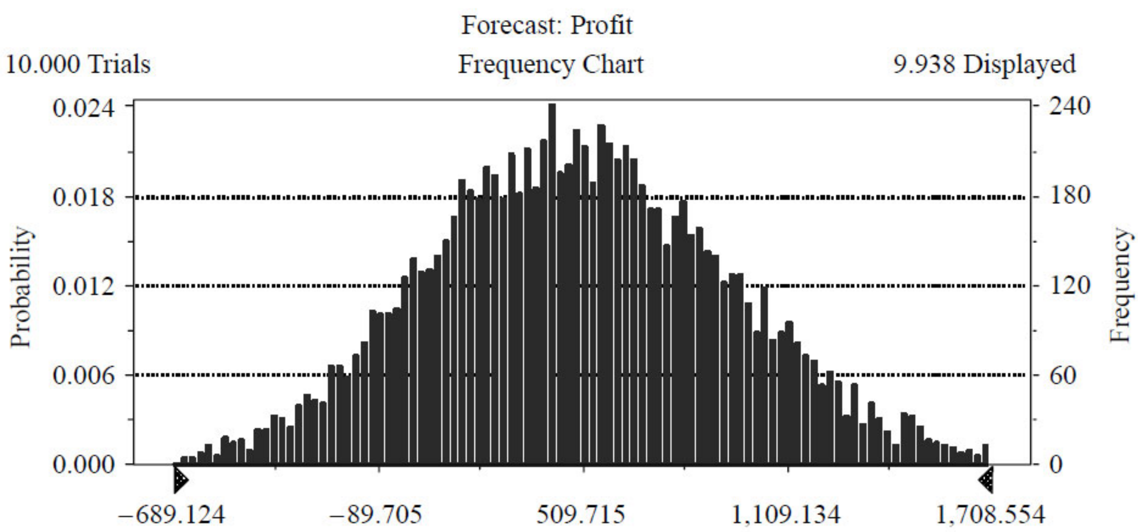
Historically, developers have relied upon static single point development appraisal models as opposed to cash-flow approaches such as DCF or NPV most often used today (Atherton *et al*., 2008). The variables that form inputs in a project's feasibility appraisal are made up of revenue and costs that have a degree of uncertainty, but the outcome of this analysis is usually given as a single value without a margin of error (Savvides, 1994). Traditional models have been enhanced and modified to allow the developer to quantify the risks they are modelling. This means moving from the idea of a best and worst estimate to a range of outcomes and a distribution (Byrne, 1995, 1996). More recent decision models presented in literature incorporate new techniques and argue that a developer can easily move away from fixed-point analysis and incorporate uncertainty in their models, which are discussed in more detail in Chapter 4 section 4.6 (Atherton *et al*., 2008; French & Gabrielli, 2004, 2006; Loizou & French, 2012).

Static point development appraisal can be considered as a rational normative model in practice, as the outcome generates a 'go'/'no-go' signal suggesting what the decision-maker should do (Byrne and Cadman, 1984). If the analyst believes in the accuracy of the assumption inputs, then they will decide upon commencing a project based on the pre-determined benchmarks of acceptability

(Atherton *et al.*, 2008). The input values become the driving force of the decision making. The inputs should be the basis for the time and effort spent thinking about decisions (Keeney, 2009).

With the inclusion of probability generation and Monte Carlo simulations, a range of outcomes can be presented in a prescriptive approach facilitating the decision maker's ability to have a greater understanding of the process by allowing amendments to the assumptions (French & French, 1997; Kelliher & Mahoney, 2000). Atherton *et al.* (2008, p. 165) described a prescriptive approach as 'one that uses normative models to guide the decision-maker within other limiting cognitive parameters. The traditional static single point models use elicitation procedures, sensitivity analysis and remodelling to gain a better understanding of the inputs and uncertainty present in each variable (Kelliher & Mahoney, 2000).

Figure 3.4.2: Oracle Crystal Ball output of probability simulations



Source: Atherton *et al.* (2008, p. 176)

Figure 3.4.2 illustrates an example presented by Atherton *et al*. (2008, p. 176) demonstrating the use of Oracle *Crystal Ball* to run probability simulations on a property development financial feasibility analysis. In this example, the mean profit was found to be €509,725 which is significantly less than the €553,578 which resulted from the traditional DCF methodology. The original figure is the best estimate available from the analyst entering in the input variables to the best of their knowledge, and the output of the simulations adds statistical significance to the estimates which has been shown to be more reliable (Dietterich, 2000). Another significant point of demonstrating the outcome of feasibility analysis in this manner is the psychological outcome of not fixating on a single profit figure but looking at a typically Gaussian distribution.

At this point, it is helpful to review the inputs and elements within a feasibility analysis of a development appraisal before outlining the specific methods used for determining go/no-go decision criteria through the use of hurdle rates.

3.4.3 Hurdle rate selection

In the preceding sections, the basis of decision making in property development has been discussed and an overview of the history and evolution of feasibility analysis has been provided. One of the key elements of determining whether to proceed with a potential property development project is the choice of hurdle rate that the project must exceed to be considered feasible or viable. As discussed in Chapter 2, the term *hurdle rate* implies that there is a minimum accepted profit or return that the development project must meet or exceed, given the level of anticipated risk in the project (Geltner *et al*., 2007). A hurdle rate can also represent the minimum expected rate of return an investment must generate to compensate for the risk-adjusted undertaking, or the return must clear the cost of capital and other financial benchmarks set for the project (Ross *et al.*, 2008). The RICS reports *The Valuation of Development Land (2008, p. 14)* makes the following suggestion concerning the choice of hurdle rate.

> *The nature of the development, and the prevailing practice in the market for the sector, helps to determine the selection of the profit margin or rate of return and the percentage to be adopted varies for each case.*

A 2017 report by the Investment Property Forum (IPF) describes a hurdle rate as follows:

> *A required rate of return or an economic profit that a potential project would need to generate for the property developer to be willing to proceed. From a property investment decision, 'hurdle rates' are linked to capitalisation rates and investment yields in capital budgeting decisions, or a required return less the forecasted long-term growth in income after allowing for depreciation.* (Hutchison *et al.*, 2017, p. 3)

The IPF report also found that among the investment managers, large-scale property investors and developers surveyed that 95% of respondents used specific hurdle rates in decision-making processes either explicitly (85%) or implicitly (10%).

3.4.4 Commonly used hurdle rate metrics

This section will provide an overview from the literature of the commonly used financial metrics used as hurdle rates for property investment and/or development projects and discuss the suitability of each to the pre-commitment stages of the development process. It is a key goal of this research to conduct an investigation and exploratory analysis regarding both the hurdle rates selected and the application of such in the early stages of the development process. An understanding of hurdle rate selection is important not only for considering current industry practice but also to measure the extent to which literature and industry diverge. It is also anticipated that a recommendation will be offered on best practice for the selection of hurdle rates for property development projects in the future.

1. Margin on Development Costs (MDC)

The hurdle rate metric that is most widely referred to in the literature regarding property development decision-making is the margin on development cost (MDC) which can also be referred to as return on cost (ROC) (Havard, 2014; Isaac *et al*., 2010, 2016; Miles *et al*., 2008; Miles *et al*., 2015; Peiser & Hamilton, 2012; Reed & Sims, 2014; Wilkinson & Reed, 2005; Crosby *et al*., 2018a & 2018b). Within the context of property investment the WACC is the primary form of hurdle rate. From an Australian perspective, Costello and Preller (2010) surveyed Queensland property developers and found development yield (another term for MDC or ROC) as the second most common financial metric used to determine feasibility (>90%) after all respondents indicated using internal rate of return (IRR). MDC is an estimate of a development profit margin based on revenue less costs, including interest for a development project. The literature states that a linear relationship exists between perceived risk and the rate of required MDC. A higher anticipated risk to the project, therefore, would require a corresponding increase in the required MDC percentage the project must achieve to warrant proceeding beyond the pre-commitment stages of the development process (Wilkinson & Reed, 2005; Reed & Sims, 2014).

Havard (2014) suggests a number of steps that need to be taken in order to estimate the MDC or ROC for a project:

1. Estimate the total development cost for the project in current dollars including interest on 100% borrowings.
2. Estimate the net sales revenue (after allowing for disposal and sales costs) based on comparable sales or through the use of income capitalisation for that part of the project which will be maintained for investment purposes.
3. Calculate the net profit (PR) by subtracting the sum of the development costs which is often described as Total Development Costs (TDC);
4. Calculate the development margin by dividing profit by TDC.

The MDC/ROC calculation can be found by using the following formula:

$$MDC\ \% = \frac{Net\ profit\ of\ development}{Total\ development\ cost} \times 100\ or\ MDC\% = \frac{PR}{TDC} \times\ 100$$

An example of using an MDC as a hurdle rate is given as below:

- A hypothetical project is forecasted through the use of comparable sales to achieve total sales of $11,000,000 not including any allowance for Goods and Service Tax (GST) which would be the development gross realisation value (GRV);
- After allowing sales commissions and disposal costs, the project is anticipated to have a net realisation value (NRV) of $10,450.000;
- The project's total development cost (TDC) is forecast to be $8,500,000;
- The anticipated profit for the project would be $10,450,000 - $8,500,000 = $1,950,000;
- The MDC = $1,950,000 / $8,500,000 = 22.94%;

- If the development project had a required hurdle rate of 20% MDC, then this project is expected to clear the hurdle rate and should be investigated further.

One of the main advantages of using the MDC or ROC method (also known as a reverse feasibility) is that it is very easy to use and calculate and can also be used for the comparison or ranking of different projects. The main weakness with this method of determining a projects hurdle rate is that it does not adequately account for a more complex pattern of income and expenditure over longer time horizons or for the time value of money (Isaac *et al*., 2010). With the advent of more complex calculations utilising spreadsheets and proprietary feasibility programs, NPV, DCF and Internal Rate of Return (IRR) have become more prominent in the literature (Havard 2014; Isaac *et al*., 2010, 2016; Reed, 2007; Reed & Sims, 2014; Wilkinson & Reed, 2005; Squires & Heurkens, 2016). However, the MDC method for determining a potential development projects' minimum profitability benchmark is still valid for projects of three years or less (Havard, 2014). It is anticipated that the majority of speculative based development projects would fall within this time frame and will be further investigated in the empirical survey.

2. Net Present Value (NPV)

The NPV of a project is the estimated present value of future cash flows minus the present value of the investment made to have the right to receive the future cash flows (Ross *et al*., 2014). For a property investment decision, this is a fairly straightforward concept of finding the present value of the expected future net cash flows or net operating income (NOI) and subtracting the present value of the cost of purchasing the property. The following equation describes the NPV where P is the price of acquiring the property asset, and V is the value of the future NOI.

$$NPV = V - P$$

or

$$NPV = \sum_{n-1}^{n} \frac{C_n}{(1+r)^n} - C_0$$

Where;

n = number of periods

r = discount rate

C_n = net cash flow or NOI during period n

C_0 = initial cost of investment at period 0

The following example of a simple property investment transaction demonstrates the calculation and use of the NPV as a hurdle rate.

Table 3.4.4: Calculation of NPV

Year	Purchase Cost	NOI	Proceeds of Sale	Annual Cashflow	Discount Factor at 8%	Present Value
0	-$ 3,000,000			-$ 3,000,000	1.0000	-$ 3,000,000
1		$ 275,000		$ 275,000	1.0800	$ 254,630
2		$ 288,750		$ 288,750	1.1664	$ 247,557
3		$ 303,188		$ 303,188	1.2597	$ 240,680
4		$ 318,347		$ 318,347	1.3605	$ 233,994
5		$ 334,264	$ 3,150,000	$ 3,484,264	1.4693	$ 2,371,332
		Present value of all years or NPV of investment				$ 348,192

Source: Author, 2018

An industrial property is purchased as an investment for a total cost of acquisition of $3,000,000. This property is already tenanted on a long-term lease and will receive NOI annually in arrears of $275,000 increasing by 5% per annum for five years, and the tenant will pay all outgoings on the property. The property will be sold for a 5% capital value increase after disposal costs at the end of year 5. The NPV of the investment, given an 8% discount rate to account for the risk-free rate and a market-based risk premium, is calculated in Table 3.4.4. As the NPV is a positive number, the building exceeds the desired return given all the assumptions and the chosen discount rate. A discount rate is commonly comprised of three different measures including an allowance for the time value of money, and inflation premium and a risk premium (Rowland, 2010, p. 146-147) The elements of the discount rate are important in that they have a large influence on a potential project's forecasted NPV.

When looking at a property development project, the 'concept becomes more involved with the addition of the time to build the project, construction loans and debt facilities as well as phased risk regimes' (Geltner *et al*., 2007, p. 756). Traditional property investment has typically involved a large outlay of capital at the outset in order to receive periodic cash flows from the NOI of the asset over its effective life. Likewise, with property development, large capital outlays to acquire a site are made early in the project with additional costs often spread out across the project timeline and revenues often being received at the end of a project (Havard, 2014). This pattern of cash flows often necessitates discounting each outflow back to the present value to account for the time value of money. The construction stage of the development process usually involves debt funding of all or most of the construction costs including the interest capitalised within the facility. This funding arrangement also gives rise to the advantage that (construction and interest cost) outflows do not affect the cash position of the property developer until the end of the project. The effect of utilising a different funding arrangement leads to property development projects having a very different economic opportunity cost of capital (OCC) than that of traditional property investment due to the different phases of the development process (Geltner *et al*., 2007).

Brealey *et al. (2007)* found that for property investment-based decisions about whether to include property in a fund's core portfolio, the NPV is the most beneficial hurdle rate that can be selected and is superior to using IRR (Brealey *et al*., 2007). However, the IPF research on hurdle rate selection and decision making for selecting property investment and/or development assets found that the IRR was the most common hurdle rate selected by European firms with 66% of respondents ranking this indicator as the most important (Hutchison *et al*., 2017). In fact, this research report found the use of NPV ranked fourth behind IRR, return on invested capital and income on cost- which can be compared to MDC or ROC in Australia. Additionally, when the decision processes of property developers were examined in the IPF report, it was found that hurdle rate metrics were the primary means of decision making, rather than a portfolio theory approach adopted by funds managers who select assets for investment purposes. In the Australian context, Costello and Preller (2010) found that NPV was the third most used financial indicator for determining feasibility by Queensland property development firms. From the perspective of property developments in Australia, New Zealand and internationally, it has been found that organisations determine feasibility on a project by project basis rather than incorporating NPV into a portfolio of projects (Hutchison *et al*., 2017).

3. Internal Rate of Return and Target IRR

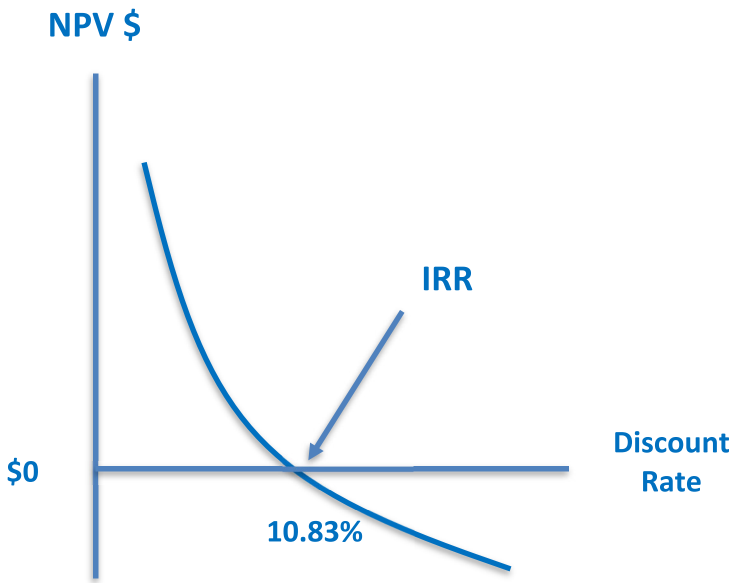
The internal rate of return (IRR) is a metric used in capital budgeting that measures the profitability of potential investments. An IRR is the discount rate that leads to the NPV from all cash flows from a particular project being equal to zero. IRR calculations rely on the same formula used to determine NPV (Altshuler & Schneiderman, 2011; Baker & Filbeck, 2013). When an IRR is used as a required or forecasted hurdle rate in project decision-making, a target internal rate of return (TIRR) is used. Using the NPV equation above to calculate the IRR, the value of the IRR is equal to r which would give an NPV of 0:

$$NPV = \sum_{n-1}^{n} \frac{C_n}{(1+r)^n} - C_0$$

This equation is illustrated in Figure 3.4.4 where an increase in the discount rate steadily decreases the NPV of an investment until it becomes negative. The IRR is found by trial and error and through the use of iterations of higher and lower discount rates and is the value of the discount rate that intersects the line where NPV is $0.

Discounting is the process of determining the present value (PV) of a cashflows' inflows and outflows by taking into account the time value of money of future value (FV) inputs (Baroni *et al.*, 2006). The time value of money refers to the phenomenon that a dollar today (PV) has an inherent value greater than a dollar in the future (FV) due to the risk of not receiving the forecasted amount. 'Investors expect a return simply because, having time up money, they have foregone the pleasure of spending it' (Rowland, 2010, p. 145). It is the rate of return expected if there was no risk of default. A discount rate is a required rate of return on a real estate investment/development based on its risk when compared with returns earned on competing investments and other capital market benchmarks (Rowland, 2010). A discount rate will often include a summation of the risk free rate (Government 10 yr treasury yield), an allowance for inflation and a risk premium commensurate with the perceived risk of the future income streams (Fisher, 1930; Baum & Crosby, 2008). For many analysts within the property development industry, the discount rates is set to a target rate of return (Regan, 2010). In the NPV example given in Figure 3.4.4, the IRR would be equal to 10.83% which would be the discount rate that gives an NPV of $0.

Figure 3.4.4: NPV of a project given different discount rates



Source: Author, 2018

As stated above, in a number of prior studies it has been found the IRR to be the preferred hurdle rate when making property investment-based decisions. When employing an IRR as a hurdle rate for decision making it is important for the organisation to set a target internal rate of return (TIRR). A *TIRR* is a required IRR set by the decision-maker as a minimum hurdle rate to which a project's forecasted return must be equal or greater than, and a TIRR converts an IRR from a measure of expected return to a 'go' or 'no-go' decision criterion. When this indicator is used, a 'go' decision is triggered when the IRR exceeds the TIRR, or when the discount rate applied to future cash inflows and outflows is greater than the required return on funds. For speculative development in Australia, the MDC is the most preferred hurdle rate as found in Preller and Costello (2010) followed by the IRR. Hutchison *et al.* (2017) found that most survey respondents did not base their required rate of return on accepted finance theory but applied a risk-free rate (usually based on government bond rates) plus a risk premium that is often formed from an in-house view to come up with a minimum acceptable IRR in a methodology similar to the Capital Asset Pricing Model (CAPM). This finding is consistent with Crosby *et al.* (2018a) which found that when an IRR was applied to UK based development viability studies, the actual return was the inverse to what would be expected from the financial literature. Longer-term projects actually produced lower IRR returns and shorter projects higher returns which runs counter to widely accepted investment decision-making theory. They argue this is due to the residual land value calculations and the point in time expenditure in the project is incurred. IPD (2010) as quoted in Crosby *et al.* (2018a) reviewed 3,500 UK based development appraisals and found that average return as measured by IRR was 7% over the period 1983 – 2008. This return was hardly more than that which could reasonably be expected from other passively held investments over this period, with a lower level of expected risk.

Crosby *et al.* (2018a) also offer the view that property developers may be using the IRR and other time value of money measures in ways that are not addressed in the wider financial literature. Within this risk premium, there were a number of approaches from 'rules of thumb to complex, layered models and *pro-forma* approaches with an absence of textbook models' (Hutchison *et al.*, 2017, p. 11). It is anticipated that when Australian property development firms are surveyed that the result will be similar to that found by Crosby *et al.* (2018a). An interesting outcome of the IPF report was the finding that 80% of respondents applied a specific hurdle to each project or investment.

4. Return on equity, equity internal rate of return and return on investment

The return on equity (ROE) and return on investment (ROI) indicators are profitability ratios used by investors to determine how much an investment will return from either earnings or capital gains/losses from changes of asset value (Adelman & Marks, 2009). This indicator is used among others 'to gauge the initial attractiveness of a development proposal which must be met or exceeded to sustain interest in a project' (Nachem, 2007, p. 433). Equity internal rate of return (EIRR) 'is used when a project is funded using a mix of equity and debt and the investor would like to estimate the rate of return on equity, after debt costs and payments are removed' (Rowley *et al.*, 2014, p. 19). This hurdle rate is an important financial metric in property development as there is a high usage of debt funding in the Australian industry. Additionally, this indicator is the leveraged version of the IRR hurdle rate metric, and when the EIRR exceeds the project IRR it indicates the project IRR exceeding the WACC (Rowley *et al.*, 2014).

Equity may be defined as 'the proprietor's capital investment in an enterprise or undertaking that is generally unsecured, high risk and illiquid' (Regan, 2010, p. 21). The ROE for a development project can be found by dividing the net profit of the development by the average equity investment from the developer over the life of the project. From the perspective of an investor investing funds into a development project, the same equation can be used to determine the ROI. The ROE or ROI achieved by a project for a development organisation or investor determines what each dollar of equity invested generates in terms of net income. The formula for determining ROE is:

$$ROE\ \% = \frac{Net\ Profit\ of\ Development}{Average\ Owner's\ Equity\ in\ project} \times 100$$

(Source: Reed, 2015)

This ratio is important for most development firms as the use of debt and leverage are commonly used and can be used to determine the return on the property developer's funds invested in the project. Preller (2009) found that approximately 50% of developers surveyed calculated the ROE and used it in decision making.

5. Payback period (PB) and breakeven ratios

The payback period is an example of a breakeven ratio which can include other measures such as sales breakeven ratio, operating breakeven (BE) ratio and expense ratio (Nachem, 2007). A payback period is a period of time required in order to recover the initial outlay from profits or savings (Brealey *et al.*, 2012). All else being equal, when comparing potential projects, the shorter the payback period the less the investor is exposed to the investment (Reed, 2015). The payback period is a measure of risk and success of a project. The payback period can be calculated by the following formula (Zuckerman & Blevins, 2003):

$$PB = \frac{Equity\ Capital\ Invested}{\text{Average Annual Project Cashflow}}$$

When a project's cash flow is not represented in 'annualised figures, such as from property development activities, then the equity cash flows must be added until they equal the sum of the equity capital invested' (Reed, 2007, p. 437).

6. Margin on revenue or return on revenue (ROR)

A margin or return on revenue is similar to the MDC or ROC calculation mentioned above, with the same advantages and weaknesses, with the exception that the total *gross realisation* (GR) or *gross development value* (GDV) of a project is used as the denominator rather than the TDC being so used. The return on revenue (ROR) is found by dividing the expected profit by the GDV or GR as demonstrated in the following formula:

$$ROR\ \% = \frac{Net\ Profit\ of\ Development}{\text{Gross Development Value}} \times 100\ or\ ROR\% = \frac{PR}{\text{GDV}} \times\ 100$$

(Source: Reed, 2015)

A survey conducted by the Royal Institution of Chartered Surveyors found that the MDC or ROC method is much more common than the ROR for development appraisals in the UK. 'The latter derives from the traditional financing of commercial developments where the completed property is sold to a long-term investor' (RICS, 2008, p. 14).

7. Weighted average cost of capital (WACC)

A WACC can be used as a hurdle rate to determine a development project's break-even point and the level of value the project derives in excess of the firm's cost of capital. Often used in as a determinate in identifying an investment's net present value, a WACC is simply the product of the annual interest rate associated with each form of capital used in project and the respective percentage weighting (Chen, 2017; Modigliani & Miller, 1958). Alternatively, the WACC can have an inbuilt requirement for a particular return on equity (ROE) which is used as a risk premium that is required to justify the organisation investing their own equity capital into a project (Geltner, 2007). In this situation the WACC would be equal to the TIRR.

8. Capital asset pricing model and an allowance for risk

The capital asset pricing model or CAPM was originally developed by Sharpe (1964) and Lintner (1965) as a means of decision-making given an investment's expected return and risk. CAPM builds upon modern portfolio theory developed by Markowitz (1959) and aims to discount future cash flows by a minimum market return and a risk-premium commensurate with the expected volatility of returns. CAPM was modified and applied to real estate transactions by Jud and Winkler (1995). The use of CAPM has the effect of restricting the number of projects an organisation can undertake, a concept that is generally known as capital rationing. *Capital rationing* is defined by Beraldi *et al*. (2011, p. 1375) as:

> *The act of limiting an organisation's potential number of projects, as capital is not infinite, and concerns the selection of a portfolio of investment projects with the aim of maximizing the total value while satisfying the capital budget constraints imposed over the planning horizon.*

The limiting factor of CAPM is achieved by requiring a higher cost of capital to permit only those projects to proceed that have a higher return on capital (Dayananda, 2002). Therefore, projects with the highest NPV will proceed and will have the effect of maximising the firm's profitability and put a restraint on the over-commitment of capital (Beraldi *et al*., 2011; Antle & Eppen, 1985). Recent studies have cast doubt upon the application of CAPM and other popularly accepted investment-oriented capital budgeting methods to property development projects (Crosby *et al*., 2018a; IPD, 2010, 2017). CAPM requires a reliable industry-based market return in order to determine the appropriate

CAPM rate, but no such reliable measure for property development exists, and the high level of heterogeneity of property development projects makes the creation of such a measure problematic. Developers do utilise DCF methods but employ other methods for the determination of an acceptable project discount rate.

9. Minimum financial metrics

It is commonly understood within the industry that many property development firms set a minimum financial metric as a hurdle rate which must be met or exceeded. These are simple ratios such as a minimum dollar amount of profit that must be achieved, a minimum profit dollar/per unit or dollar per square metre, or a minimum dollar amount of the project size or revenue (Gau & Kohlhepp, 1980, Costello & Preller, 2010). These measures are very simple to calculate but can be highly useful. For example, a property development organisation sets its minimum project size to be $10 million based on GR. This minimum size is a valid hurdle rate because the organisation's experience using a 20% MDC required profit yields their minimum acceptable profit given their staff resources and company overheads. Development feasibility and the financial metrics associated with hurdle rates are a project-specific exercise that usually does not take into account the company's project portfolio or the company overheads associated with running the project (Bulan *et al*., 2009). A minimum dollar amount is a valid screening tool to avoid utilising resources on projects that are not value accretive to the company as a whole (Holland *et al*., 2000). Surveys conducted with property developers as respondents such as Hutchison *et al*. (2017), Crosby *et al*., (2018a & 2018b), Preller (2009) Costello & Preller (2010) and Weigelmann (2012) found that many property developers utilise other simple financial metrics. One explanation for the heavy reliance on simple financial ratios is offered by Crosby *et al*. (2018) in that the more popular quantitative techniques used in longer-termed property investment do not accurately reflect the risk/reward realities of property development projects. One such example includes the accepted axiom that the longer a project/investments time horizon, the higher the discount rate required to compensate for the greater levels of uncertainty and risk in the future. Therefore, risk and time are linear. In regards to property development projects, this is often inverse to reality, as in the example of some long-term land development projects (Crosby *et al.*, 2018a).

3.5 Elements of feasibility analysis within a development appraisal

A feasibility analysis includes a financial analysis but will contain additional elements including an executive summary, market study, preliminary drivers, cost estimates, photographs and map information for the site, information about financing, planning permissions, an estimate of value and an analysis of project risk (Havard, 2014; Greer *et al.,* 2013; Miles *et al.,* 2015; Rowley *et al.*, 2014).

Additionally, an analytical section should include the following areas:

- Sensitivity analysis with an evaluation of each component and variation of the plan, to move from feasible to optimal;
- A review of risks in the optimal configuration, with appropriate risk management techniques; and
- Confirmation that the project is feasible for each participant. (Miles *et al.*, 2015, p. 251)

A range of critical and analytical issues have been identified from the literature which should be considered when completing a feasibility study from where the following aspects have been collated and include Havard, 2014; Wilkinson & Reed, 2005; Reed & Sims, 2015; Miles *et al*., 2015; Miles *et al*., 2000; Peiser & Frej, 2003; Rowley *et al*., 2014).

3.5.1 Critical analysis aspect of a feasibility study

1. The conceptual idea and market for the project, from the concept down to a specific absorption schedule, then the particular market niche under current conditions:
    a. national, regional and local market outlook,
    b. demographic attributes of the target market,
    c. sales and rental comparables,
    d. market segmentation including the identification of key marketability traits,
    e. evaluation of existing supply.
2. Compilation and analysis
    a. incorporate the assumptions into a DCF model,
    b. perform sensitivity and/or scenario analysis,
    c. review risks and optimal configuration,
    d. confirm that the project is feasible.

The completion of the conceptual market information early in the life of a development project, as well as the completion of a thorough financial feasibility analysis, are considered essential for informed management decision-making in the pre-commitment stages of the development process.

3.5.2 Determining a development project's objectives

Before undertaking a feasibility analysis for a development project, it is important to identify clearly the key objectives that the project needs to fulfil. In order to delineate objectives within the project, the feasibility problem needs to be defined (Kolbe *et al*., 2013). The required development objectives should be determinable and establish the basis for determining hurdle rates and inform the 'go/no-go' decision output of the financial analysis. The development objectives must also be able to be measured and a judgement made on whether they can or will be achievable (Havard, 2014).

As all projects are unique, the reasons for undertaking a project often differ requiring specific objectives to be set for each one. The viability analysis will determine if the minimum hurdle benchmarks have been satisfied and, if so, will result in a 'go' decision and help guide the decision-maker as to 'when to go' (Mayer & Sommerville, 2002).

It is imperative that the decision-makers deciding whether to proceed with a project have a clear idea of what they want their project to achieve prior to undertaking the feasibility analysis of a development appraisal (Havard, 2014). In relation to financial gain, it is important to distinguish the goals of the trader-developer verses the investor-developer. The trader developer will primarily create real assets for the purpose of on-selling at a higher price than the cost to complete the project, therefore, deriving an economic profit. An investor-developer will generally have a longer investment horizon and will be looking at the value of longer-term income streams that have been discounted from the future value to present value. The difference in primary development objective will determine which hurdle rates and financial performance metrics are utilised in the feasibility analysis and ultimately which development sites and projects will proceed past the go/no-go decision point.

a. Non-Financial Development Objectives

Most trader and investor developers prioritise economic profit as the primary objective for initiating a project but many projects are undertaking for additional reasons (Earl, 1995; Jones, Bell, & Earl, 2003). Feasibility analysis can also be used for projects where the primary objectives are not financial gain with the addition of techniques such as cost-benefit analysis (Aye *et al*., 2000). Wilkinson *et al*. (2015. p. 77) described the traditional approach to determining viability as:

> *Under the paradigm of conventional project appraisal, the assumption is made that the object of carrying out development is to achieve a 'single bottom line' profit. No account is taken of external costs of the development carried by the community or other stakeholders.*

With governments that are looking at infrastructure and other projects where social value is the main objective, the social benefits will far outweigh the project's IRR (Regan, 2015; Smith, 2007). Public and quasi-private/public organisation may not state that deriving economic profit is their primary objective, but often there exists the impetus of accountability in their allocation of resources and so will need to strive to obtain the maximum benefit/social value return (Smith, 2007). To determine which projects are to proceed, these organisations need to undertake a development appraisal which includes financial feasibility analysis. Social objectives may include providing land supply, increasing housing affordability, regional economic stimulus, transportation and/or meeting other community objectives for example.

b. Financial motivation as a property development objective

Both traditional trader-developers and investor-developers usually will have their primary development objective to derive economic profit and the management of risk (Havard, 2014). Ultimately, this goal aims to obtain the highest risk-adjusted profit possible when choosing between possible projects. Economic profit is usually measured as a surplus of revenue to costs or an allowance for the time value of money such as an NPV.

3.5.3 Determining a development project's boundaries and limitations

Now that the primary and secondary development objectives have been determined and the purpose for development defined, it is important to examine the boundaries constraining the project and other limitations that could restrict the project from achieving its objectives. Project constraints exist that may place a 'complete bar on the development taking place at all, but most will establish the limits of the development – the physical limits, the legal limits and the market limits' (Havard, 2014, p. 25). There are many areas of limitations and boundaries placed upon a project, but they can generally be sorted into the following categories: Site availability and restrictions, permissions and planning, legal and contractual, market factors including supply and demand, broader economic climate, financing and the availability of capital, and political issues (Armitage, 1999; Havard, 2008).

There is a common misperception that design consultants or architects are the primary drivers in determining what should and can be developed on a particular site (Havard, 2014). Usually, this process is well advanced before any consultants are engaged, and the developer will have a good understanding of what can and should be developed in order to meet the project's objectives. The breadth of limitations imposed upon a development project goes far beyond just the legal restrictions imposed by planning instruments, and it is the development appraisal which plays an integral role in defining this process (Havard 2014). The five principle external considerations that need to be evaluated include the planning framework, political issues, the property market, project finance and legal issues are discussed in turn.

a. The planning framework

Urban planning is primarily concerned with shaping the urban landscape of the future (Ward, 2002). The shaping is primarily done through the development control process which can be described as 'a process by which society, represented by locally elected councils, regulates changes in the use and appearance of the environment' (Audit Commission, 1992 as quoted in Carmona & Sieh, 2004, p. 7).

The value of a real estate development project or a development site is intrinsically linked with the planning and permission instruments placed upon and governing the possible development schemes or options. Ricardo's Law of Rent states that the ultimate value of a property is derived from the rents that can be obtained from that property or, in modern terminology, the Net Operating Income (NOI) that can be derived (Ricardo, 1821, 1913). The NOI of a property or a completed development project can be ascertained by a study of market rents for comparable properties. Milton Freidman's Efficient Market Hypothesis is demonstrated in the determination of market rents and the combined market transactions in a particular area will influence the potential NOI of a project (Friedman, 1977).

Microeconomic theory identifies that the price of a property is the result of the interaction of supply and demand and hence will determine a market rent (Barras, 1994). The supply of land or property is rarely a determinant of the actual amount of physical land in an area (Exceptions exist, e.g. Singapore or

Monaco where there is a fixed amount of land that can be used.) Australia is a large continent that is mostly uninhabited and contains vast expanses of vacant land, but the physical supply of the land does not form the supply that determines the value of a particular property or development site. The available supply of developable land is determined by the planning mechanisms and the physical infrastructure that will allow the creation of NOI from the use of a site (Hilber & Vermeulen, 2016; Albouy & Ehrlich, 2018). An example of this limit to supply would be the area of land allocated to retail shopping centre use and development. Planning schemes purposefully limit the provision of retail shopping centres to allow for existing centres to adequately provide for the population and to allow for businesses to be able to succeed (Guy, 2006). Too much retail space and businesses will not be able to draw enough customers to be successful; too little, and the customers will have to travel a long way (England, 2000). The supply of retail shopping centres is scarce, which allows existing centres to achieve an increased level of NOI that corresponds to an increased valuation than would be possible if the supply was less scarce. Residential property is much more abundant in Australian cities. Therefore, the NOI and values of residential property are lower per m2 than what would be expected for retail shopping centres.

As the supply of any allowable use for property development is fixed and scarce, the developer can generate an economic profit from increasing the supply permissible on a given development site by applying for a change of use or increasing floorspace density (Gyourko & Molloy, 2015). For example, in Queensland Australia a *material change of use* (MCU) is the common terminology for this process and is defined by the *Planning Act (Qld) 2016, p. 298* as the following:

> *The start of a new use of the premises; (or) the re-establishment of the premises of a use that has been abandoned; (or) a material increase in the intensity or scale of the use of the premises.*

Seeking appropriate development approvals is a vital task within the development process and will form a significant boundary to the potential project. As noted above in Queensland, a property developer can seek to have the planning scheme governing their site amended through application for an MCU. This process can be either impact assessable or code assessable in Queensland as defined by the *Planning Act (Qld) 2016* as follows:

- *Code assessment – an assessment that must be carried out only against the assessment benchmarks in a categorising instrument for the development; and having regard to any matters prescribed by regulation… (*Planning Act QLD, 2016, p. 56).

- *Impact Assessment is an assessment that must be carried out against the assessment benchmarks in a categorising instrument for the development; and having regard to any matters prescribed by regulation may be carried out against, or having regard to, any other relevant matter, other than a person's personal circumstances, financial or otherwise* (Planning Act QLD, 2016, p. 56).

Code assessment based MCUs are typically easier to obtain and present a lower level of risk to a project than having to obtain an impact assessable MCU where the project must be advertised and objections can be made to the proposed development scheme. The planning limitations of a development project present a major limitation and also present one of the key risks to a project. Furthermore, the time period to obtain development project planning approval poses a significant risk to a project and can have a negative impact on the required TIRR. Newell and Steglick (2006) surveyed Australian property developers and found that approval or planning risk was the second-highest risk category a project faces after environmental risks. They also found that property development firms employ a number of risk minimising strategies concerning planning and permissions including analysing if extra approvals are needed before acquiring a site, investigating the level of development approval conditions and contributions and actively meeting and communicating with local government councils (Newell & Steglick, 2006). Property development project risk and uncertainty will be further examined in Chapter 4.

b. Political issues

Housing affordability, negative gearing, foreign investors, capital gains tax concessions and environmental concerns have become regular topics of interest in the political and media landscapes in both Australia and New Zealand. The manner in which governments, at the federal, state and local levels, respond to the above issues can have a dramatic impact on development projects. A change in policy from the Foreign Investment Review Board (FIRB) could immediately impact most of the projects potential buyers and could turn an otherwise successful development into a disaster. This particular situation has recently impacted on planned Australian property development projects do to a change in policy in 2018 (Ciesielski, 2019). The potential for political interference has the potential to increase as society has increasingly viewed housing affordability and the taxation of property investments as issues that could have a major impact on society. Additionally, the balance of society's views on the right of the individual and their landholdings versus the rights of society to impose control over the individual's rights has increasingly shifted towards the benefits to society at (Platteau, 2015). It is now more important than ever to consider changes in political issues and how that could impact on a development project meeting its key objectives.

c. The property market and the broader economy

There are many economic factors that influence a development project and may place limits on the development that is deemed feasible. Growth in disposable income, employment levels, inflation and monetary policy are some of the economic indicators which influence the optimal development matrix and the speed and size of a project. Supply and demand factors play a major role in the determination of the price, profitability and the absorption of a development project into the market (Baum, 2015).

d. Project Finance and Capital Raising

Project funding has a major impact on how a developer determines which projects are feasible and should be undertaken. The ease and price of capital in both debt and equity forms is often the determining factor in the optimum size of development projects (Rowley *et al.*, 2014). The process of completing a feasibility study to determine if a project is viable will usually start long before there is any contractual relationship with a site or a project.

3.6 Feasibility methods commonly used in development appraisal

The primary methods of determining feasibility in development appraisal are derived from Ricardo's Law of Rent and are based on the premise that the value of a development project or site is taken as the residual amount after all costs and required profit are accounted in the development equation (Baum & Crosby, 2008). The development equation is primarily used in two ways in the pre-commitment stages which include the residual land value method and when a land price is entered and the residual profit is determined. There are numerous examples of development equation models, but all have in common the underlying principles which include:

Value of the completed development project (Gross Realisation)

Less –

All cost inputs including design, permissions, consultants, construction (both civil and structural), sales and marketing, government fees and taxes

Less –

The required profit for the project given the risk associated with the project as specified by Hurdle Rate or Target Return

Equals –

Residual Land Value, is the maximum amount that can be paid for the site or bid at auction after the costs associated with acquiring the site are allowed (Havard, 2014, Isaac *et al*., 2016)

When examining an asking price for a potential development site the above equation can be re-arranged as follows in order to see if the profitability of the project will clear the required hurdle rates:

Value of the completed development project (Gross Realisation)

Less –

All cost inputs including design, permissions, consultants, construction (both civil and structural), sales & marketing, government fees and taxes

Less –

Residual Land Value, which produces the maximum amount that can be paid for the site or bid at auction after the costs associated with acquiring the site are allowed

Equals –

The required profit for the project given the risk associated with the project as specified by Hurdle Rate or Target Return
(Sources: Isaac & O'Leary 2012, 2013; Isaac *et al*., 2010, 2016; Havard, 2014)

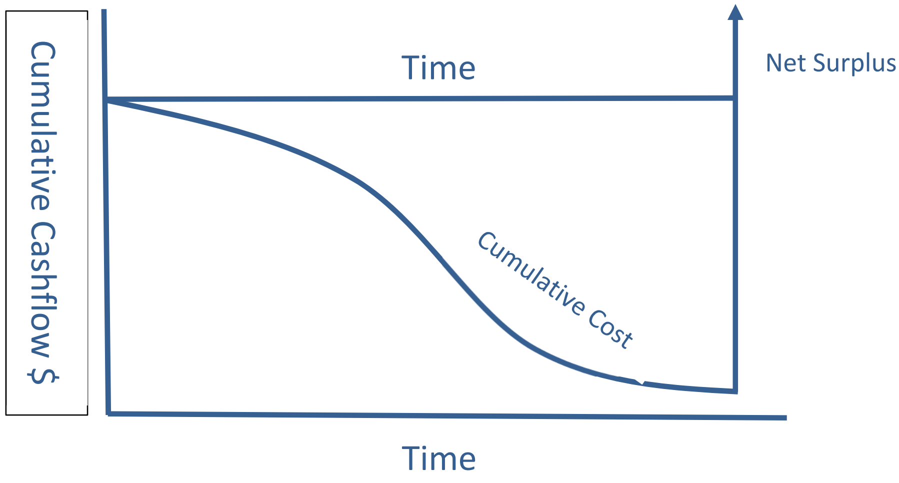
The above equations are very simple, but the complexity in preparing a development appraisal comes from the accuracy that must be used to determine the input variables in both price and timing. The project analyst is forced to forecast many variables possibly for ten years or more, which creates a great deal of uncertainty in the process. The forecasting of development variables of both cost and revenue can be demonstrated in the waterfall of risk (Leinberger, 2007). The waterfall of risk refers to the payout schedule within a cashflow typical of many property development projects. Project expenses or outflows progress from the start of the project up until the end of the construction and registration periods where income in the form of sales and/or rents can be received (Gimpelevich, 2010). When the next expenditure and receipts in a project are illustrated graphically, projects typically demonstrate a steady decline in the net funds received until the end of the project with a rapid influx of capital. The shape of this typical cashflow often will illustrate a waterfall.

Havard (2014) describes steps in completing a feasibility analysis for a potential project as follows:

1. First, determine the inputs: This includes making an assessment of the input costs which may include land and acquisition, building costs, professional fees, statutory charges as well as forecasting sales and revenue.
2. Determine the length of the project: This step includes estimating how long each stage of the development process will take and assigning inputs to specific time periods. The timing of cost outlays and revenue inputs is illustrated in Figure 3.6. It should be noted that Figure 3.6 illustrates the sales settlements occurring at one point at the end of the project rather than over a period of time.
3. Determine the effect of time on interest and finance charges
4. Determine the residual amount (FV)
5. Discount the future value residual land and profit value back to present value (PV)

The determination of profit and/or residual land value through a development equation is a common component of determining project viability. More complex quantitative analysis within feasibility programs still aims to solve the basic equation described above and seek to provide an answer to the go/no-go decision point in justifying if the forecasted profit is sufficient given the identified risk of the proposed development project (Currie & Wesley, 2009).

Figure 3.6: Cumulative cost vs time



(Source: Havard, 2014, p. 20)

3.6.1 The development equation

The basic process of development appraisal is to calculate the development equation and to determine either a project's potential profit or the residual land value as a method of valuing a development site's maximum contract price. The equation is a step in validating all the revenue and costs associated with a proposed property development project although, in practice, is not formatted as an algebraic equation (Robinson, 1989).

$$PR = (1 + i)^{-t}[V - DC - L]$$

Where:

L = residual profit allowed for risk valued at time t = 0

i = the discount rate which includes the developer's weighted average cost of capital (WACC) + a risk premium

t = development period

V = estimate of the development value on completion

l = estimated purchase price of the development site plus all acquisition costs associated in procuring the site, of Profit and Risk allowance determined by selected benchmark or hurdle rate

PR = The required profit for taking on the project risk

DC = development costs excluding land and acquisition costs.

The following equation is a highly simplified version of the residual land calculations expressed in numerous valuation texts (Havard, 2014; Isaac *et al*., 2010; Ratcliffe *et al.*, 2004; Wilkinson & Reed, 2005):

V = B + F + MS + PR + L

or

L = V - (B + F + MS + PR)

Where:

L = residual land value

V = project gross realisation

B = building and development costs

F = finance and capital costs

MS = marketing and sales costs

PR = required profit for taking on project risk.

Kolbe *et al*. (2013, p. 357) offers the following observations on the property development process:

> *Property developers and investors are effectively placing their equity at risk based on a set of assumptions about the development scheme's ability to generate the anticipated revenue in the future. Feasibility analysis addresses the likelihood that the project's objectives will be achieved.*

The simplicity of the development equation belies the complexity of factors that influence the input assumptions and further exacerbates the difficulty in accurate forecasting. Therefore, the development equation is a summation of the forecast of a series of future uncertain events (Havard, 2014).

3.6.2 Residual land value

Development sites or vacant land need to be analysed for a potential development project which has no inherent intrinsic value at this stage, but a determination of value can be made by examining the potential uses for which the site can be developed. The latent value of a site is known as a residual land value (Harvard, 2014). The term *residual* refers to the portion of the value in a project that is left over after allowing for all the cost inputs and a pre-determined profit figure and subtracting this from the forecasted net revenue. This remaining residual value is a determinant of land value (FV); this value can then be discounted back to the PV in order to allow for landholding costs across the development period. (See Isaac *et al*., 2010, p. 67 and Havard, 2014, p. 63 for specific calculations demonstrating that the residual amount of the equation is a future value of the land that should then be discounted back to present value.) The traditional use of the RLV is a static calculation that does take into account the time value of money (Havard, 2014). Each specific development scheme or development option will have a unique residual land value, and property developers will frequently evaluate many potential schemes in order to compare residual land values. The theory of site value necessitates two pre-conditions (Fraser, 1993) before a project can commence based on the given assumptions that the motive for undertaking property development is to derive economic profit. These pre-conditions are:

a) The expected value of the completed development must exceed the cost of the site and all development costs, including a sufficient level of profit for the developer.
b) The value of the site for development purposes must match (or exceed) its value for an existing use. (Fraser, 1993, p.230)

When a development site has been placed on the market, competing firms will undertake the development appraisal process and will determine the residual land value for various schemes in order to ascertain the maximum bid price they are willing to offer. This process of scheme evaluation will result in a range of values, and the vendor will usually sell to the highest bid that a prospective developer can make while still achieving their target return (Havard, 2014). The analyst at this stage crosses over to the area of valuation and development appraisal and seeks to answer the question of the value of a specific site. A number of development options or schemes can be put forward by the analyst and through the process of completing a feasibility analysis each development option will end up with a unique value (Isaac *et al*., 2016, Ratcliffe *et al*., 2009). The iterative nature of this process should lead the analyst to development options that have a higher residual land value and therefore towards the highest and best use (from an economic profit perspective) for a site (Jefferies, 2017, Wilkinson & Reed, 2005).

3.6.3 Discounted cash-flow method

The equation below demonstrates the calculations required when the discounted cash flow (DCF) method is used to determine residual land value. Rather than a simple rough estimate of finance charges, revenue and expenditure are broken up into even time events (usually monthly or quarterly) and finance charges are calculated on the cumulative cash-flow at that point. Cash flow methods differ from the static RLV method in that the method is dynamic. The net cash-flow in each time period is then discounted by the appropriate discount factor.

$$L = R_0 + \sum_{n}^{1} \frac{R}{(1+i)} + \frac{V}{(1+i)^n}$$

Where:

L = residual land value

R_0 = project gross realisation

R = b

V= f

n = periods in the cash flow

(Havard, 2014)

As discussed in section 3.4.4 discounting is the process of determining the present value (PV) of a cashflows' inflows and outflows by taking into account the time value of money of future value (FV) inputs (Baroni *et al.*, 2006). In the DCF method of feasibility analysis, each net cash flow of a project's inputs and outputs during a given cashflow period (e.g. months or quarters) is discounted from a FV to a PV, usually using the WACC or TIRR for the project (Havard, 2014). The PV for each cashflow period are then summed to determine the PV of the development project over the project's development term.

3.6.3.1 Key advantages of the DCF method of feasibility analysis

A key advantage of both the DCF and residual cashflow accommodation method over the traditional static traditional residual land value approach is that the addition of the element of time to the analysis allows for more accurate estimation and forecasting of project inflows and outflows. Additionally, they give the analyst the ability to answer the question of when capital is likely to be needed or received (Havard, 2014). A severe limitation of the traditional static residual land value approach is the inability to forecast interest payments within a project and necessitated the utilisation of an approximation method which could be inaccurate.

A limitation of the use of the DCF method of feasibility analysis includes the FV periodic cash flow being discounted to PV using the WACC. The result of the discounting does not allow for the calculation of forecasted interest payable over the development project's cash flow, and creates a limitation on the practical use of a DCF methodology in determining a projects' future cashflow requirements (Havard, 2014). Specifically, this problem arises because the WACC is used as the discount rate and is not entered as a specific project cost. Additional limitations are offered by Gimpelevich (2010), Atherton *et al*. (2008) and Young (2007) which include the difficulty in determining and selecting an appropriate discount rate as well as the difficulty in determining future income and expenses and also estimating an appropriate terminal value. Often the shortcoming of the DCF method are addressed through the extensive use of sensitivity analysis (Gimpelevich, 2010). The DCF method represents a quantifiable method of determining a site or project's value, but ultimately ends up in an intuitive judgement as the key discount rate is chosen based on the analyst's experience (Baroni *et al*., 2006).

3.6.4 Residual accumulation cash flow method

The residual accumulation cash flow method (RACFM) is similar to the DCF method but differs in when and how discounting occurs and the calculation of interest (Havard, 2014, p. 75). It should be noted that the specific term of residual accumulation cash flow feasibility method is rarely used in practice, but accurately describes the process a method of determining project viability. This method may falsely be ascribed as the DCF method, but significant differences exist. Finance charges are calculated on the cumulative cash-flow at for each period based on the project's expected weighted average cost of capital (WACC) and expected loan to value ratio (LVR) or in the case of property development projects the Loan to development cost ratio (LDCR) (Havard, 2014; Isaac *et al.*, 2010, 2016). The FV residual value at the end of the cash-flow is then discounted back to a PV using the appropriate discount factor.

An advantage of the RACFM method is that it allows the project analyst to make a more accurate estimation of project cashflows in specific cash flow periods and estimate the projects capital requirements (Havard, 2014, p. 75). The DCF method often assumes full borrowings and discounts the cash flow by the projects WACC, where the RACFM method allows for the provision of specific debt and equity arrangements to be modelled (Havard, 2014). It should also be noted that both cash flow methods can be calculated in a single Microsoft Excel worksheet. The DCF method allows for the determination of a project NPV, while the RACFM allows for the forecasting of inflows and outflows for each specific cash flow period. As discussed in Chapter 1 in the research questions, this research aims to assess the level of adoption of the different feasibility methods and particularly the use of specific land valuation methods.

3.6.5 Market comparison method of determining land value

An additional method of determining the value of a proposed site (or land) for a potential property development project is the market comparison method. This method relies on the substitution effect inherent as an economic process of knowledgeable individuals choice in order to create an efficient market (Wyatt, 2007). This method can be defined as ‘selecting comparable properties on the basis of their elements of comparison which includes key transaction information such as date, price paid, market rent, and yield’ (Wyatt, 2007, p. 111) Decision-makers involved in the acquisition stage of the development process may choose to examine multiple sales of similar property development transactions in order to help guide their view regarding a site’s value. This thesis will investigate the use of the market comparison method of determining site value in an empirical survey.

3.7 Summary

The purpose of this chapter was to provide a review of the literature and theory regarding the practice of determining project viability in property development projects through the use of feasibility analysis. The recent history and evolution of feasibility analysis practices for property development were also discussed. The practical aspects of completing a feasibility analysis for a project has also been addressed. Decision methods and hurdle rate selection were discussed and past research concerning the application and use of hurdle rates in decision making literature was reviewed. Particular methods of determining site value were discussed including the traditional static residual land value method, the dynamic methods of discounted cash flow and the residual accumulation cash flow method and the market comparison method. Chapter 4 will review risk and uncertainty in relation to property development projects and Chapter 5 will discuss the research methodology.

Chapter 4: Risk & Uncertainty in Property Development Decision Making

4.1 Introduction

The prior chapters have explained the development process and examined the role of feasibility analysis in property development decision-making. This chapter will provide an overview of how risk and uncertainty are present in property development projects and outline key literature concerning the identification, measurement and evaluation of risk. As this research is primarily concerned with the detection and management of potential risks at the pre-commitment stages of the development process, specific risk analysis methods commonly used in feasibility analysis will be reviewed. Additionally, this chapter will provide a background of the evolution of the theory of the identification of risk and uncertainty. Finally, methods and strategies for risk transference by project development companies will also be considered.

In order for a property development project to be considered successful, the project must meet key objectives, and development managers must be prepared to assume risks and face uncertainty. Risk identification, measurement and management practices in the area of property development practice have increasingly become more significant as a result of past financial crises and the rising complexity of the property market (Weigelmann, 2012). *Risk management* as a practice includes the undertaking of risk identification, measurement of the outcome of identified risks, transfer of risk to others when feasible and the costing and management of risks that are retained and cannot be transferred

(Regan *et al.*, 2010). Leading property developers in Australia have acknowledged that 'improving risk identification and management practices are essential to maintaining their discipline while bidding for work and undertaking projects' (Newell & Steglick, 2006, p.26). In fact, the ability to recognise, measure and manage the risk of a project and plan for uncertainty in the development process are essential for effective decision making as the benefits of decisions are weighed against the costs related to bearing and managing them (Rodger & Petch, 1999).

Before delving into the processes of risk identification and management practices within the property development industry, it is important to explore the roots of risk management theory and explain the differences between risk and uncertainty**.** The concept of risk is often bound up with the term uncertainty, and it is necessary to separate the terms. *Risk* can be defined as an occurrence of a future event that may produce an outcome different from what was anticipated (Regan, 2010). Both risk and uncertainty highly influence a development project's success or failure, so it is imperative that decision-makers have the ability to be able to identify and manage risk and use quantitative tools, such as probability analysis, to give some predictability to key variables (Csiszar, 2008). Uncertainty cannot be managed but can be planned for in many circumstances. In relation to identified risks, in most applications, these can be predicted with accuracy, but sample size and limited data will compromise the outcome (Regan *et al.*, 2010; Mintah *et al.*, 2018).

Frank Knight in his 1921 work entitled *Risk, Uncertainty, and Profit* made a key distinction between risk and uncertainty in considering whether the likely occurrence of an event can be measured. This idea of separating those events where a probability of occurrence can be assigned from those that cannot created a key milestone in risk management theory. Though Knight's works are often debated in relation to their true meaning, it is often interpreted to be that risk is an event where the outcome can be measured, whereas in *uncertainty* the outcome of the event cannot be directly measured (Friedman, 1976). In this view, risk applies to situations where the outcome is unknown, but we can accurately calculate the event's likely occurrence (Knight, 1921; Langlois & Cosgel, 1993; Friedman, 1976).

Another common interpretation of Knight's work is that the distinction between risk and uncertainty arises not because there is no basis for assigning probabilities to events, but because there is not a reasonable way of classifying the likely outcomes of the event (Langlois & Cosgel, 1993). Taking this interpretation of Knight's work, a risk to a development project can be described as whether a project meets the targeted income, cost and timing variables by an anticipated date. The outcomes of this event are known, either the forecasted variable was achieved and, if not, then the consequences are known and can be measured in terms of financial gain or loss. A specific example that is often considered critical to a project's success would be achieving the required pre-sales percentage level required for institutional funding before the construction phase of the development cycle. The result of failing to achieve the desired pre-sales results in the project not procuring the finance needed to commence construction and this outcome can be specifically measured. As the outcome can be measured, the probability of a risk event can generally be ascertained using statistical and actuarial estimation methods (Regan, 2015; Coiacetto & Bryant, 2014).

The example above of a risk event can be contrasted with an example demonstrating uncertainty, where the outcome categories are unknown. Risk can be distinguished from uncertainty which can be described as the occurrence of an unexpected event. Examples of uncertainty include civil unrest(in some countries), natural disasters and political upheaval, where it is not possible to undertake reasonable probability estimation (Regan, 2015). In such a scenario, the outcome of the project as a result of the uncertain event remains unknown and unmeasurable (Langlois & Cosgel, 1993). The distinction between risk and uncertainty emphasises a very important aspect of property development and feasibility analysis, being that of distinguishing between variables that represent risk and variables that represent uncertainty. Often uncertainty arises out of having partial knowledge, which could be attributed to many variables in a property development project and needs to be addressed (Langlois & Cosgel, 1993; Knight, 1921).

In cases of uncertainty, decision-makers in property development projects are required to fall back on judgement and intuition as well as information at hand. French and Loizou (2012) argued that even when development appraisers utilise quantitative methods of analysis such as Monte Carlo simulations to put boundaries around the consequences of risk, they are based on the analyst's heuristic intuition. Additionally, it is recognised that increases in uncertainty can affect the behaviour of the decision-maker, making them less likely to begin a new project (Bloom, 2014), and can cause a downturn in the construction and development industry (Bloom *et al*., 2018).

The difference between judgement and intuition can be described, in relation to a property development organisation's decision structure, as a process of 'logic by recognizing that the former is not reasoned knowledge, but judgement, common sense or intuition' (Knight, 1921, p. 211). Byrne (2002) describes uncertainty, as separate from risk, in that it is anything that is not known about the outcome of a venture at the time when the decision is made. When risk is taken to be the measurement of a loss, identified as a possible outcome of the decision (Byrne, 1996). The separation of the two terms allows for the isolation of variables that have a degree of uncertainty from the overall riskiness of the project from the perspective of the decision-maker.

4.2 History of risk management theory

When looking at the foundations of risk theory, one is taken on a journey through human history and soon comes to the understanding that this topic is central to people's most primal beliefs. The origins of risk theory are found in the transition from a fatalist's view to that of a reasoned understanding of the sovereignty of humankind and to that of being in control of one's destiny (Bernstein, 1996a). Prior to this understanding, it was generally believed that the locus of control lied with a great power and the outcome of events were pre-ordained. From the understanding that events can be either random or under the control of people to an understanding of probability and utility theory emerging (Bernstein, 1996b).

4.3 Risk management and uncertainty at the pre-commitment stages of the development process

This section provides an overview of the application of risk management theory and specifically risk identification practices as well as the planning for project uncertainty during the pre-commitment stages of the property development process discussed in Chapter 2 as well as a discussion of Prospect Theory.

4.3.1 Prospect Theory

A key distinction between risk and uncertainty was introduced by Tversky and Pollatsek in a *Theory of Risk*, where risk is regarded as a characteristic of options or events which can be meaningfully ordered for riskiness. Prospect theory states that the risk of an event is related to the variance of its outcomes (Pollatsek & Tversky, 1970, p. 541). Prospect theory is distinct from *Coombs' theory* which postulates that individuals have an ideal risk level and that when choosing between equal probability events, the individual selects the event that is closer to their ideal risk level (Coombs, 1964).

It is generally accepted that Tversky and Pollatsek are demonstrating that risk is not simply intuitive or a perception which is closer to what would be referred to as uncertainty but is mathematically quantifiable and able to be measured and ordered as the probability of occurrence of a series of options. Since risk can now be quantified, it can then be applied to risk management techniques to deal with the probable quantifiable outcomes of a risk event. Total risk can also be defined in the following formula:

.

$$Rt = Rf + Rp$$

Where:

Rt = total risk

Rf = risk-free rate of return

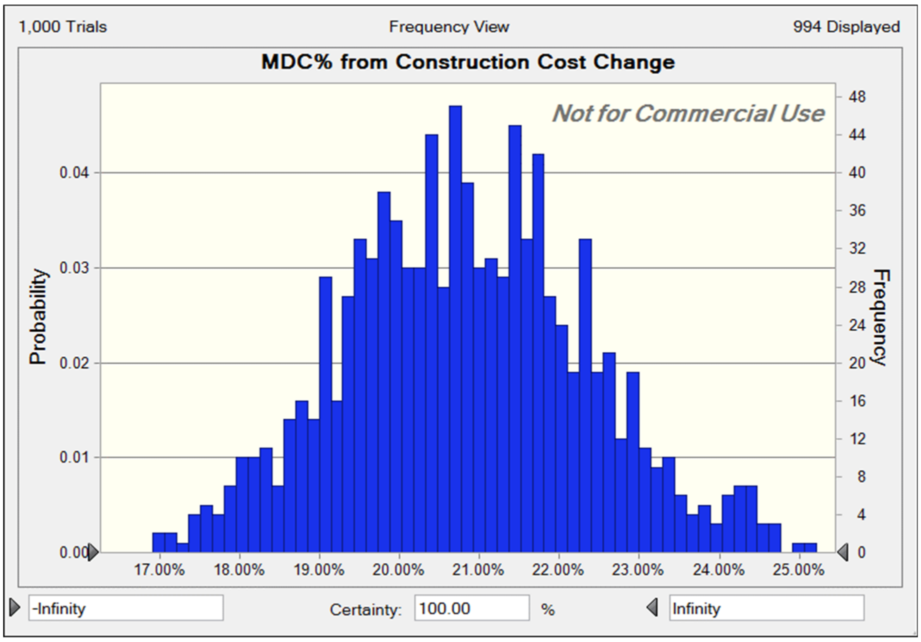
Rp = risk premium

(Regan, 2010)

An example of the quantification of risk to a property development feasibility analysis would be the defining of a probability of a change in a forecasted variable and measuring the impact of this change once applied to the project. Another key factor affecting the developer is the aspect of time which further changes the probability of specific events happening (Dixit & Pindyck, 1994). Figure 4.3.1 illustrates the outcome of running 1,000 Monte Carlo simulations using Oracle's *Crystal Ball* on the forecasted construction costs of a development project and the impact of this change on the projects MDC percentage.

The construction costs were forecasted using a log-normal distribution as construction costs are more likely to run overbudget than underbudget on development projects (Mbachu & Cross, 2015; Larsen *et al.*, 2015). The mean forecasted MDC percentage for this project was approximately 21% but ranged from 17% - 25% with the distribution tails having a very low probability of occurring. This analytical exercise helps to put boundaries around the outcome of a project given a risk event occurring.

Figure 4.3.1: Monte Carlo probability simulations of the MDC% change of a project as a result of a change in construction cost



(Source: Author, 2018)

4.3.2 Distinctive characteristics of property as an asset class

To investigate the decision-making processes of property developers and how they address both uncertainty and risk, it is important to have an understanding of some of the unique characteristics that make real property assets different from other asset classes, and how these characteristics influence the levels of risk in property development projects.

In regards to influencing the property development process and decision making, there are a number of important and unique attributes of real property that distinguish this asset class which includes *interalia*,

1. Long-term supply lag in the creation of improvements to real property.
2. Large capital expenditure is usually a requirement.
3. The presence of externalities including the indivisibility and fixed location of assets.
4. High transaction costs associated with the acquisition, disposal and permissions required in many jurisdictions.
5. Due to the lease provisions common in renting real estate, income is highly correlated with inflation, thereby creating a hedging effect.
6. Regarding large commercial, retail and industrial assets, infrequent valuations and a small number of sales transactions have the effect of smoothing prices and understating volatility.
7. Improvements on land are a depreciating asset with a limited life that gives rise to certain taxation and capital characteristics.
8. Diversification benefits of property and REITs.

(Baum, 2012, 2015)

a. The supply lag in property markets

The development process including obtaining permissions, design and documentation and the construction of buildings is a complex set of activities that are also highly labour intensive (Reed & Sims, 2016). Due to these factors, the timeframe for a development project can often extend for many years. During the market analysis stage of the property development process, the developer is actively trying to forecast the demand many years into the future and trying to bring on specific supply to meet the forecasted demand. The vulnerability of this process to changes in the market, oversupply from other players in the industry, internal and external economic shocks, and legislative and political currents often leads to an imbalance in supply and demand (Isaac *et al.*, 2016). This imbalance is a major contributor to the property cycle as the market fluctuates from undersupply to oversupply in response to the broader economic environment and the credit cycle. The supply of real property is highly inelastic whereas the demand for real property is highly elastic (Baum, 2001b; Baum. 2009).

The supply lag combined with the highly elastic demand curve for real property greatly increases the risk inherent in property development projects. A major question property developers must answer is will the demand for which you are designing a project for today be dramatically changed when the project is delivered to the market (Havard, 2014)? The transference of this risk is possible in some forms of development where a buyer is sourced for the completed product before the commencement of a project (Staiger, 2018). In residential speculative property development, this would involve the requirement to achieve a fixed percentage of pre-sales that would be targeted before receiving construction funding. Many funders in Australia require 100% of the debt funding to be covered by pre-sale contracts to transfer risk away from the developer to the buyer (Bryant, 2012). A primary purpose for the requirement of pre-sales includes the mitigation or transfer of risk prior to financiers making a formal commitment.

b. Transactions in property require large capital commitments

The large amounts of either equity and/or debt capital required to transact property assets are often many times larger than any other asset class (Rowley *et al*., 2014; Miles *et al*., 2007). Share markets, bond market, derivatives, commodities, interest-bearing securities and other asset classes often have the inherent advantage of being highly divisible and intangible as a physical asset that can make the transaction process much easier. Commercial and retail properties can in many instances exceed a billion dollars in a single transaction. In an attempt to transfer the increased risk to large capital commitments and the lack of liquidity in real property, developers have adopted the use of strata titling and asset securitisation to try and overcome some of these disadvantages, but the vast majority of real property is transacted under a single title. Additionally, 'development is all about risk and return; debt finance helps reduce the risk for the developer and allows those without the upfront capital to undertake projects' (Rowley *et al*., 2014, p. 2).

c. Indivisibility and fixed location of assets

Real property assets have a fixed location (except in rare circumstances such as moving a house on stilts) that cannot be moved to a more advantageous location. Despite the more recent rise in the securitisation of real property assets, the legal and regulatory requirements in accessing this form of legal structure render the cost and ability beyond most investors and developers do to the licensing and compliance requirements. The risk inherent to a specific market often cannot be diversified away due to the capital limitations of firms, and the labour intensity of their projects render this impossible (Baum, 2015). So, with specific risk among other types of risk being very high, the decision process and selection of projects becomes even more significant.

d. High transaction costs associated with acquisition and disposal of real property assets

The process of acquisition and disposal of land and any improvements has a high level of associated costs (Ibbotson & Siegel, 1984). For example, in Queensland Australia, the acquisition perspective, purchasing property development sites in Australia will commonly incur costs of approximately 3% - 7% of the contract price (McCluskey & Franzsen, 2017). This cost primarily comprises stamp duty and includes site inspection, legal fees and conveyancing.

The disposal cost of real property assets including sales commissions, marketing and legal costs is generally accepted to be in the range of 3% to 7% of the contract price. With high entry and exit costs in the property market, the risks associated with making a poor decision, or a change of mind regarding the acquisition of a development site, are increased beyond the risks associated with transacting other assets classes such as shares, bonds or cash.

e. Real property asset rental yields are regulated by leases which provide an inflation hedge

The process of having a well-defined body of legislation and a long history of common law adds a unique aspect to real property. Leases specify the amount, periodicity and time frame for rental income which smooths out the volatility of investment yields. Particularly for commercial, retail and industrial property leases, there is often a clause enabling increasing rental income in line with inflation. 'Real estate yields are thought to reflect risk-free rates of return, a risk premium and expected growth in cash flows' (Baum *et al*., 2018, p. 1). Research has shown that property values are ultimately linked to the rental income derived from the property, and this then gives rise to real property having an inbuilt inflation hedge (Baum, 2009). This aspect of property as an asset class gives lenders a higher level of confidence into the serviceability of debt over property and also contributes to the low cost and relatively high levels of leverage available for property acquisition (Huston, 2015). The well-defined body of law that govern the income streams of property helps transfer the risk of a project by allowing for pre-leasing activities before project commencement (Fuerst & Matysiak, 2013; Leiser & Groh, 2014).

4.4 Risk identification practices in property development

4.4.1 An overview of uncertainty and risk in the development process

The property development process is inherently risky and therefore requires a correspondingly high reward in the form of profit for decision-makers to make a formal commitment (Byrne, 1996, 2002; Havard, 2014; Miles *et al.*, 2008; Newell & Steglick, 2006, Gehner, 2008; Rowley *et al.*, 2014). When examining the past returns of property development projects, profit levels and return on equity can range from incredibly high profits to very large losses, making the standard deviation of returns exceptionally wide (Havard, 2014). There are a number of reasons given in the literature that offer explanation for this phenomenon including the long supply lag in the built environment requiring long forecasting of many variables, the sensitivity of the financial outcome of a project to key input variables and the scale and complexity of inputs to many projects (Cadman & Topping, 1995; Havard, 2014, Gehner, 2008).

There are some aspects of uncertainty that are, to an extent, within the developer's control, and can be identified, measured and contained. Others are much more difficult to control and analyse and must be accepted as part of the risk of development (Byrne, 2002). Time is another major factor influencing the uncertainty and risk in development projects. It is a commonly accepted part of the development process that as a project proceeds from one stage to another the degree of certainty increases while the freedom for making changes is reduced (Byrne, 1996; Newell & Steglick, 2006). The simplest and shortest development projects rarely involve a timeframe of less than six months but most projects involve many years. Greenfield land subdivision projects, for example, can often spread over many years. A small number of projects will span decades, with a local example being Stockland Ltd.'s Aura development in Caloundra, Queensland; which has a development timeline of approximately 30 - 40 years ("Stockland starts construction of Aura," (2015).

Feasibility analysis during the pre-commitment stages of the development process occurs at the beginning of this time frame yet necessitates the assumption and use of variables across the entire development timeline. These variables have a high degree of uncertainty and are much more difficult to control and analyse and must be accepted as part of the risk of development (Byrne, 2002; Uher & Toakley, 1999). Also, due to the inelasticity of supply and development time lag between the conception of the project and its completion, property development is especially vulnerable to changes to social, economic and financial factors (Baum, 2009; Byrne, 2002). Newell & Steglick (2006) also identified the top ten development risk factors ranked in a survey of 24 publicly listed Australian property developers which are identified in Table 4.4.

If there existed a hypothetically perfect development project that would improve the environment, cure all social problems in the locality, create a high level of economic profit for the developer and also enjoys complete political and community support there would still be a high degree of uncertainty and risk involved in such a project. By adding the elements of time, there is the risk of a change in the assumption variables such as market price and/or construction cost which could cause this project to fail. The occurrence of an economic shock during the development process, once a formal commitment has been made and the project commenced, means it is increasingly difficult to make changes to the project (Herring & Wachter, 1999; Hilbers *et al.*, 2001). An example of this occurring in the Australian market, is Juniper Development's *Soul* project situated on the Gold Coast Queensland, where the pre-commitment stages of the development process occurred prior to the GFC, the construction occurred during the downturn in the property cycle and the final stages of the development process occurred during the recovery in the property cycle. Such a situation arises when new supply comes onto the market at a time when the demand characteristics that justified the project at the beginning of a development timeline have changed, exacerbating the effects of the property cycle in line with the boom/bust nature of property development (Baum, 2001, 2009; Key, 1994). By selecting those elements which a developer has some control over regarding uncertainty, the analysts can be in a better position to make informed decisions (Byrne, 2002).

Table 4.4: Top 10 property development risk factors

Risk factor	Average risk rating
1st : Environmental risk	4.25
2nd : Time delay risk	4.14
3rd : Land cost risk	3.88
4th : Acquisition terms risk	3.75
5th : Approvals risk	3.63
5th : Cost increases risk	3.63
7th : Political risk	3.50
7th : Experience risk	3.50
7th : Engineering risk	3.50
10th : Market risk	3.38
10th : Delivery timing risk	3.38

(Source: Newell & Steglick, 2006, p. 35)

4.4.2 The risk analysis process in determining a property development project's feasibility

Savvides (1994) outlined a risk analysis process for feasibility analysis and project appraisal which is illustrated in Figure 4.4.2. The first step is 'the requirement for a robust model capable of predicting correctly if fed with the correct data' (Savvides, 1994, p. 5). It is worth noting that all future based data will be a forecast in nature and therefore, will have a margin of error. This step requires the analyst to prepare a traditional feasibility analysis using expert opinion, known revenue and costs and the analyst's experience as the best estimate of the input variables for the project. The output of the traditional feasibility analysis will give either a fixed dollar profit for the project or result in a residual land value if the analyst is choosing to determine site value.

The second step is to complete a single variable sensitivity analysis on key variables where a change in the variable has a large impact on the overall outcome of the project. This may include sales value projections and construction costs, which are two key input variables that are known to have a significant impact on a project's overall profitability (Crudden, 2012; Havard, 2014). Sensitivity analysis is used to 'identify the most important variables in a project and measures the responsiveness of the project result by a fixed deviation' (Savvides, 1994, p. 5). A key limitation of sensitivity analysis is that the percentage of deviation of each variable is subjective to the opinion of the analyst.

The third step in the process is to complete the probability distribution and define the limits or ranges of the key variables. During the third stage it is important to limit the probability analysis to only the most important variables as described by Savvides (1994, p. 6).

> *The reason for including only the most crucial variables in a risk analysis application is twofold. First, the greater the number of probability distributions employed in a random simulation, the higher the likelihood of generating inconsistent scenarios because of the difficulty in setting and monitoring relationships for correlated variables.*

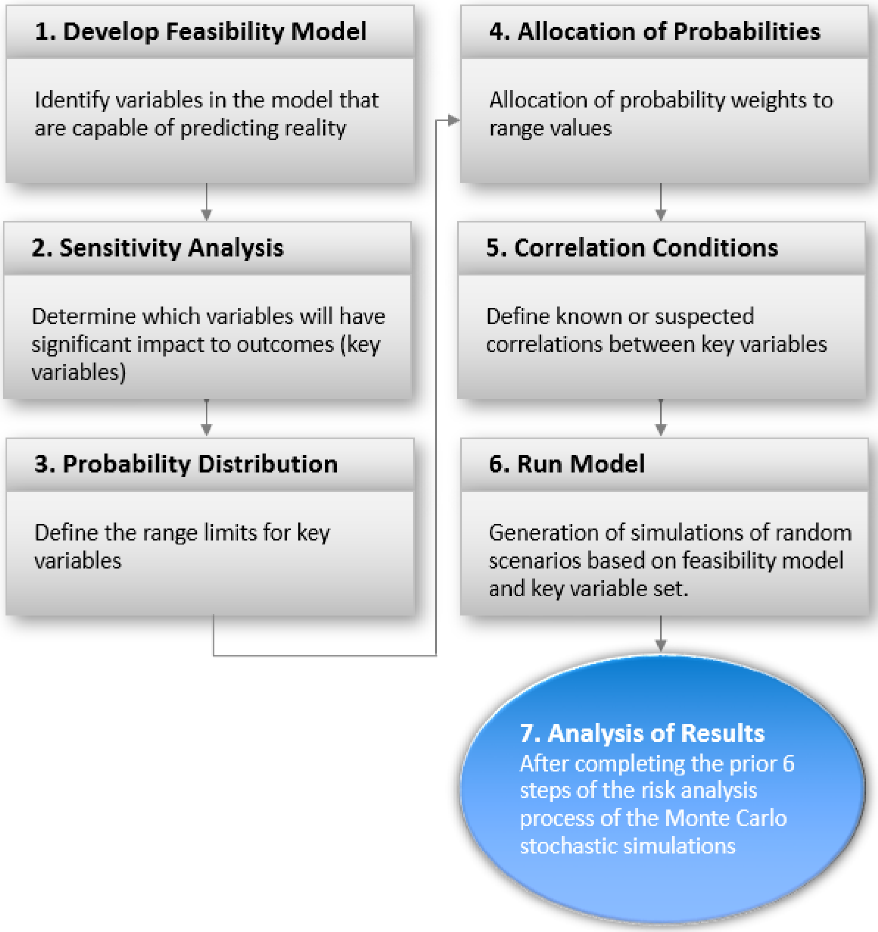
Another requirement at this stage is to estimate the range of uncertainty regarding the key variables that will be tested in the probabilistic simulations. This can be obtained by either expert opinion or by analysis of past projects. At this point in the development process, some inputs may have reduced uncertainty as they may be governed by contractual relations. For example, construction costs being locked in a fixed-priced method of procurement will reduce the level of uncertainty regarding the cost and profitability of the project. Additionally, other costs can be locked into a project early on in the development process. Other methods of obtaining the range of uncertainty within variables include the use of the Delphi Method or relying on external research and advice (Hughes, 1995; Crudden, 2012).

The fourth step is to make an allocation of probabilities to the chosen key variables in the analysis. The figures used in the traditional feasibility analysis are often the starting point at this stage as described below by Crudden (2012, p. 23):

> *Since there is a 'most likely' outcome for a variable (this will be the single value used in deterministic analysis), it follows that other 'less likely' outcomes must have a lower probability of occurring. Ascribing probabilities to these outcomes is what differentiates stochastic analysis from the conventional, single number, deterministic approach.*

Each value within the predetermined range of variable outcomes has an equal chance of occurrence. Probabilities are allocated to fit a distribution curve within that range. The curve may be log-normal as in the case of sales values per m2 when the likely hood of a decrease is greater than that of an increase and where the value cannot go below zero. Other types of distribution curves include normal Gaussian, triangular, uniform, discrete or binary (Doucet *et al*., 2001). The outcome of this stage is essentially that 'distribution profiles are used to express quantitatively the beliefs and expectations of experts regarding the outcome of a particular future event' (Savvides, 1994, p. 8).

Figure 4.4.2: Risk analysis process for investment appraisal



Source adapted from: Savvides (1994, p. 5) and Crudden (2012, p. 21)

The fifth step in the risk analysis process is to identify correlations between key variables. Two or more variables can be considered to be correlated if the variance of their values moves together in a systematic manner (Savvides, 1994). The problem with the correlation between variables in feasibility analysis and probabilistic simulations is that such correlations violate the required principle of randomness. For example, the sales commission paid on residential real estate transactions is often based on a percentage of the contract price and therefore would be highly correlated with the sale revenue forecasted in feasibility analysis. The inclusion of highly correlated variables can lead to 'a biased and distorted outcome that is off-target' (Savvides, 1994, p. 9). Where possible, it is best to avoid such correlations and combine variables that may be highly correlated before running the simulations.

The sixth step is to run Monte Carlo stochastic simulations to determine the probability of the outcomes for the key variables and also the impact on the project's required hurdle rates. Finally, step seven involves analysing the results and cumulative probabilities of different outcomes for the project. This allows the decision-maker to move away from fixed-point profit and hurdle rate outcomes and look at the results as a range with associated probabilities.

The most commonly used risk analysis methods utilised within the property development industry will be discussed in section 4.6 after a discussion of risk attitudes and mitigation strategies in section 4.5.2.

4.4.2 Summary of prior studies of the risk analysis practices of property developers

Prior studies have surveyed the risk management attitudes and the risk analysis tools used by those in the property industry. Newell and Steglick (2006) surveyed 24 leading property development companies listed on the Australian

Stock Exchange (ASX), finding that 'property developers use a range of sophisticated quantitative and qualitative procedures to assess the various elements of property development risk' (Newell & Steglick, 2006, p. 36). Their research also found the use of standardised risk analysis techniques being used in decision-making by Australian developers included preparing a financial feasibility model (100%), the use of specific financial hurdle rates (100%), the use of sensitivity analysis (87.5%), the use of DCF models (75%), the use of probability models (37.5%), and the use of risk simulations (25%) (Newell & Steglick, 2006, p. 29).

Wiegelmann (2012) and Gleibner & Wiegelmann (2012) analysed the results of a survey of European property development firms concerning their risk management processes and attitudes. This research found the use of standardised quantitative risk assessment methods included sensitivity analysis (43.5%), scenario analysis (43.5%), Monte-Carlo simulations (10.1%) and the value at risk method (7.2%). Additionally, this research found European developers typically used a largely intuitive approach to risk assessment and did not necessarily stick to rigid structures of analysis. Finally, the results of the survey revealed that decision-makers in European development organisations viewed their firm as having a similar to slightly risk-averse risk tolerance perception in relation to their competitors.

Lyons and Skitmore (2004) surveyed project risk management practices in the Queensland engineering and construction industry which included a small number of property developers. This research found, among property developers, a high level of risk tolerance, very high levels of intuition and judgement in risk analysis and high levels of quantitative risk analysis methods. Additionally, a sensitivity analysis was the predominant method used with lower levels of usage for Monte-Carlo simulation and probability analysis.

Uher and Toakley (1999) surveyed the risk management practices in the conceptual phase of commercial development construction projects. Their research focused on stakeholders involved in the construction and development industry in Australia, of which 37 of the 200 respondents were property developers, with the majority of respondents being construction managers, quantity surveyors or government employees. The survey found property developers had a higher level of risk-taking than other stakeholders in relation to attitudes to risk which is higher than that found in other studies. It should be noted that the different periods of time of various studies may account for the difference in risk attitude and perception.

Gehner (2008) researched a number of Dutch real estate development organisations and found that developers knowingly take risks in projects and that the core of their business is making decisions by taking on risks to derive a return. Additionally, this research described a justifiable investment decision as 'taking a risk in the context of real estate development is achieved by following a procedural rational decision process, which results in a timely, justifiable and accountable investment decision' (Gehner, 2008, p. 256).

As described in Chapter 3, Preller (2009) surveyed Queensland property development organisations about their decision-making and feasibility practices in the preliminary stages of the development process. This research found that 90% of respondents completed sensitivity analysis and some form of risk analysis in their feasibility analysis.

Hutchison *et al.* (2017) conducted a survey of UK property development and property investment organisations and found that few respondents had risk analysis embedded in their decision-making process. However, this research found that most respondents utilised some form of sensitivity analysis, and many incorporated some form of scenario analysis with a particular focus on downside risk. Additionally, they found only one respondent regularly used Monte Carlo approaches and a few had tried stochastic simulation techniques but had abandoned their use in favour of more informal techniques. This research found 'no use of (and little awareness of) real option approaches' in decision making (Hutchison *et al.*, 2017, p.36). This report also investigated the use of quantitative probabilistic frameworks in project risk analysis, with more reliance on experience and judgement for setting variable parameters and also the use of qualitative frameworks and investment committees (Hutchinson *et al.*, 2017). Another important observation from this research was the finding that larger organisations were more likely to have robust risk analysis systems in place and smaller firms were more reliant on informal approaches. This result will also be investigated from the Australian perspective in this research.

This section has reviewed prior research concerning the risk analysis methods used by property development organisation, and the following section will provide an overview of common risk analysis methods used by property developers in the industry.

4.5 Common methods used in feasibility analysis to address uncertainty and risk in property development projects.

Developers need to question the input assumptions that are used to determine the potential project's viability. Opera (2010) argued that it is these assumptions which underpin the very basis of viability and form the key indicators of uncertainty for a given project. French and Loizou (2012) found that uncertainty is an integral part of the overall development process and also needs to be reflected in the development appraisal. As traditional feasibility analysis models in the property development industry focus on a fixed-point method of determining viability, it is necessary to explore how changes to these variables would affect the outcome of the project. Without this process, if the developers' forecasts are over-optimistic, then the residual value of the land and the expected profitability of the project will be overestimated, thereby reducing the expected risk in the project (MacFarlane, 1995). Methods commonly used to help assess the impact of a change in variables include single variable sensitivity analysis, multiple variable scenario analysis and Monte Carlo simulations (Khumpaisal & Abdulai, 2010).

4.5.1 Sensitivity analysis.

The recognition of sensitivity implies an acknowledgement of uncertainty. The development process involves dealing with many uncertainties that are problematic when approached from the standard industry-accepted feasibility analysis methods. Commonly accepted models give equal weighting to the importance and impact of different variables and are deterministic in nature (Byrne, 2002). A complete analysis would include a thorough investigation of the level of uncertainty inherent in each of the input variables that were used to determine project viability. These can include income variables such as market capitalisation rates, net operating income, sales forecasts and costs inputs including financing (French & Loizou, 2012). Projects often have a high degree of sensitivity to a small change in key variables as each possesses a degree of uncertainty. Havard (2014, p. 80) offered an explanation for such high sensitivity to changes in input variables in the following:

> *The reason for this is that the outcome of the development appraisal is actually the marginal difference in the ratio between costs and value. A slight change in this ratio can cause a major percentage difference in this marginal outcome.*

The occurrence of a risk event may be measurable and the likelihood of occurrence very small, but the impact of the event can have a major impact on the key project hurdle rates (Havard, 2014; Huston, 2015). This effect is also magnified by the heavy use of leverage in development projects due to the characteristic of very high capital costs involved (Rowley *et al.*, 2014; Bryant, 2012). Property development projects are subjected to inputs with a high level of variance such as rents, yields, sales $ per square metre which have a disproportionate impact on a project's gross realisation (Havard, 2014, Baum *et al.*, 2018).

Development appraisals are prepared on the basis of estimates because actual figures are not available and external information is sought regarding variables to reduce the levels of uncertainty as much as possible. All development appraisal is an act of forecasting which cannot be avoided and all forecasts have a degree of uncertainty and error (Byrne, 2002). The process of determining the assumption variables is deterministic and that the analyst must choose the best estimates available. Often this information comes from current prices and sales available today and then a form of escalation is applied until the point in time when the cost or income will likely be incurred (Havard, 2014).

A *sensitivity analysis* can be defined as changing a variable singularly by a set percentage that is often incremental and determining the impact of this change on the key financial metrics of the project (Havard, 2014, p. 81). In relation to the pre-commitment stages of the development process, the chosen project hurdle rates that are used for determining the go/no-go decision are used as the financial metric. This process will give the analyst the ability to determine which key input variables will have the greatest influence on the decision to proceed. Additionally, the break-even point for a project is often measured to determine the impact of pre-determined percentage changes in key variables before the project would become unprofitable. Common variables chosen for sensitivity analysis include sales rates $ per square metre, rental $ per square metre, yields, capitalisation rates, construction costs, interest rates and residual land values (Havard, 2014; Miles *et al.*, 2008).

Sensitivity analysis aims to identify the key variables that will most affect the outcome of the project, the dual purpose being:

1. To place these variables clearly before the decision-maker so that, as and if the development proceeds, these critical variables can be particularly watched for changes which may affect overall viability.
2. To enable the values of the variables put into the model to be considered more carefully so that as far as possible their values are 'best estimates' of their performance. (Byrne, 2002, pp. 59- 60)

Table 4.5.1: Single variable sensitivity analysis

Original Variables	
Sales Value	$5,500,000
Profit (FV)	$907,911
Cost of Capital	-$61,315
Construction Cost	-$1,733,550
Development Cost Including Interest - Ex Land & Acquisition	-$2,517,089
Development Cost Inc Interest + Including Land & Acquisition	-$4,092,089
Gross Realisation	$5,000,000
Land Value including Acquisition	-$1,575,000

Change in Sales Value						
$ Sales Value	$ GST	$ Net Sales	% Change	$ Development Cost	$ Profit	MDC %
$5,775,000	$525,000	$5,250,000	5.00%	-$4,092,089	$1,157,911	28.30%
$5,720,000	$520,000	$5,200,000	4.00%	-$4,092,089	$1,107,911	27.07%
$5,665,000	$515,000	$5,150,000	3.00%	-$4,092,089	$1,057,911	25.85%
$5,610,000	$510,000	$5,100,000	2.00%	-$4,092,089	$1,007,911	24.63%
$5,500,000	$500,000	$5,000,000	0.00%	-$4,092,089	$907,911	22.19%
$5,390,000	$490,000	$4,900,000	-2.00%	-$4,092,089	$807,911	19.74%
$5,335,000	$485,000	$4,850,000	-3.00%	-$4,092,089	$757,911	18.52%
$5,280,000	$480,000	$4,800,000	-4.00%	-$4,092,089	$707,911	17.30%
$5,225,000	$475,000	$4,750,000	-5.00%	-$4,092,089	$657,911	16.08%
$4,501,298	$409,209	$4,092,089	-18.16%	-$4,092,089	Breakeven	0.00%

Source: Author, 2018

Table 4.5.1 demonstrates a simple single-variable sensitivity for a hypothetical project analysing a change in sales from -10% to +10% in pre-determined 2.5% increments. This sensitivity analysis demonstrates that the hypothetical project demonstrates that even a relatively small change in the sales values forecasted would have a significant effect on the profitability of the project in units of MDC %. Additionally, this sensitivity illustrates that the breakeven point for the project would be a fall in projected sales values of 18 per cent. If the required hurdle rate for this project was 20% MDC, then a 2% drop in the forecasted sales values would deem the project unacceptable. In order to improve the outcome of the sensitivity analysis, the analyst will often include a more dynamic form of modelling with the use of 'what-if' scenarios and probability distributions of key variables.

4.5.2 Scenario Analysis

Scenario analysis takes sensitivity analysis one step further in order to address 'what-if' questions. By allowing multiple variables to be changed the analyst is able to address the interdependence of many input variables. It is generally accepted that there are two types of scenario analysis commonly used in the development industry and these are simple or *basic what-if scenarios* and *probability linked scenarios* (Mun, 2006). Basic scenarios attempt to measure the impacts of two variables which may move together, upon the project's profitability or residual land value and also measure the variables' influence on the required project hurdle rates. Basic scenario analysis is illustrated in Figure 4.5.2 and Tables 4.5.2a and 4.5.2b. Common variables for basic scenario analysis include sales value, sales time-period, construction cost, construction time-period, land acquisition and the weighted average cost of capital.

In probability-linked scenario analysis, the analyst attempts to assign a probability to the likelihood of a given scenario occurring (Havard, 2014). A common output of probabilistic scenario-analysis is to generate an estimate of three outcomes which are optimistic, neutral and pessimistic for the development project (Mun, 2006). These probabilities and scenarios are usually subjectively based on the analyst's intuition but are a useful tool for decision-makers (Havard 2014). A probability-linked scenario can also be used as an additional analysis to add depth to feasibility analysis or as a method of input variable generation when high levels of uncertainty are present which will feedback into the standard appraisal (Byrne, 2002).

Table 4.5.2a: Original base case variables for use in simple or basic 'what-if' scenario analysis

Simple 'what if' scenario analysis

Original Variables		
Gross Income (inc GST)	$	5,560,000
GST	$	478,182
Net Income (after GST)	$	5,081,818
Construction Cost	$	3,173,288
Land Cost (Asking Price)	$	525,000
Interest Cost	$	108,031
Professional Fees	$	150,750
Marketing & Other Costs	$	255,000
Total Development Cost	$	4,212,069
Profit	$	869,749
MDC %		20.65%

Variables to change in scenario analysis:

+ - 10% Construction Cost

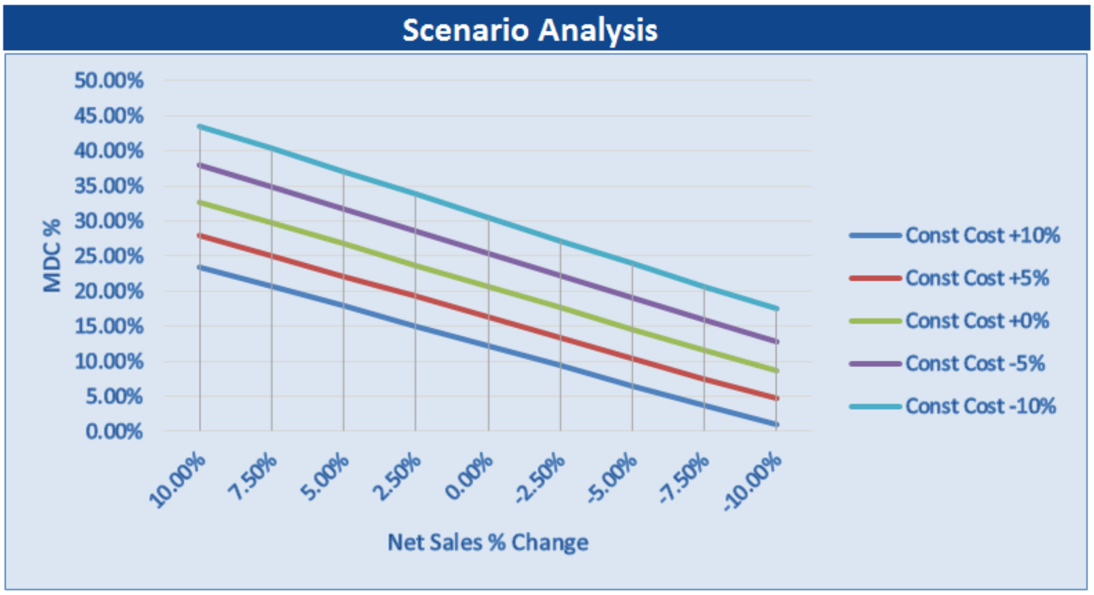
and/or

+ - 10% Net Sales Income

Source: Author, 2018

In the case of adding depth to a variable calculation in a traditional feasibility analysis, expert opinion is sought to estimate probabilities of the likelihood of a fixed change from an input variable that has already been calculated. For example, the construction cost for a building may have been estimated to be $20,000,000. A probability distribution would place the probability of this pricing as being the final price based on the expert opinion of a project manager. The distribution then may move away from the calculated estimate by increments of $250,000 and probabilities assigned.

Figure 4.5.2: Simple or basic 'what-if' scenario analysis showing change in MDC % from a change in the construction cost and net sales variables



Source: Author, 2018

Byrne (2002) suggests the analyst to seek the opinion of experts to create ranges of expectation for forecasted variables. For example, the analyst may seek the opinions of a number of construction project managers regarding their opinion for construction costs of a building methodology or for a specific development scheme. Seeking a number of opinions will give a range of values based on current conditions in the industry. The development analyst, after consulting expert opinion, must make a final prediction of the likelihood of each input assumptions and the outcome of the entire development process. During the pre-commitment stages of the property development process, this process requires forecasting to the end of the project creating further complexity in the analysis (Thekdi & Lambert, 2012). Table 4.5.2c illustrates the use of expert opinion-based scenario analysis.

Table 4.5.2b: Change in MDC % from a change in net sales and construction cost -10% to +10% in simple or basic 'what-if' scenario analysis

MDC % Change					
Net Sales %	Const Cost +10%	Const Cost +5%	Const Cost +0%	Const Cost -5%	Const Cost -10%
10.00%	23.42%	27.90%	32.71%	37.91%	43.53%
7.50%	20.61%	24.99%	29.70%	34.77%	40.26%
5.00%	17.81%	22.08%	26.68%	31.64%	37.00%
2.50%	15.00%	19.18%	23.67%	28.51%	33.74%
0.00%	12.20%	16.27%	20.65%	25.37%	30.48%
-2.50%	9.39%	13.36%	17.63%	22.24%	27.22%
-5.00%	6.59%	10.46%	14.62%	19.10%	23.96%
-7.50%	3.78%	7.55%	11.60%	15.97%	20.69%
-10.00%	0.98%	4.64%	8.58%	12.83%	17.43%

Source: Author, 2018

Table 4.5.2c: Expert opinion showing optimistic, base case and pessimistic derived scenarios

Variables	Original Base Case	% Optimistic	Value Optimistic	% Pessimistic	Value Pessimistic
Gross Income (inc GST)	$ 12,122,500	3.00%	$ 12,486,175	-5.00%	$ 11,516,375
GST	$ 1,052,045		$ 1,135,107		$ 1,046,943
Net Income (after GST)	$ 11,070,455		$ 11,351,068		$ 10,469,432
Construction Cost	$ 7,058,483	-5.00%	$ 6,705,559	7.00%	$ 7,552,577
Land Cost (Asking Price)	$ 550,000	-5.00%	$ 522,500	10.00%	$ 605,000
Acquisition Costs	$ 27,500	0.00%	$ 27,500	0.00%	$ 27,500
Markeing $ Sales	$ 482,205	0.00%	$ 482,205	0.00%	$ 482,205
Interest Cost	$ 135,906	-5.00%	$ 129,111	10.00%	$ 149,497
Professional Fees	$ 494,094	-5.00%	$ 469,389	10.00%	$ 543,503
Contingency Allowance	$ 352,924	0.00%	$ 352,924	0.00%	$ 352,924
Infrastructure & Other Costs	$ 831,278	0.00%	$ 831,278	15.00%	$ 955,969
Less: GST Input Credits	-$ 765,701		-$ 728,189		-$ 811,928
Total Development Cost	$ 9,166,689		$ 8,792,277		$ 9,857,247
Profit	**$ 1,903,765**		**$ 2,558,791**		**$ 612,185**
MDC %	**20.77%**		**29.10%**		**6.21%**

Source: Author, 2018

4.5.3 Monte Carlo Simulation

A Monte Carlo simulation is a quantitative technique used in many decision analysis models that takes the probability-linked scenario analysis further as a quantitative technique (French and Loizou 2012). Even with the use of expert opinions, the scenario analysis as a group of 'what-if' outcomes, is still based on an educated guess and does not offer any statistical validity. As stated above, high levels of uncertainty exist in many input assumptions in a financial feasibility analysis for a property development project.

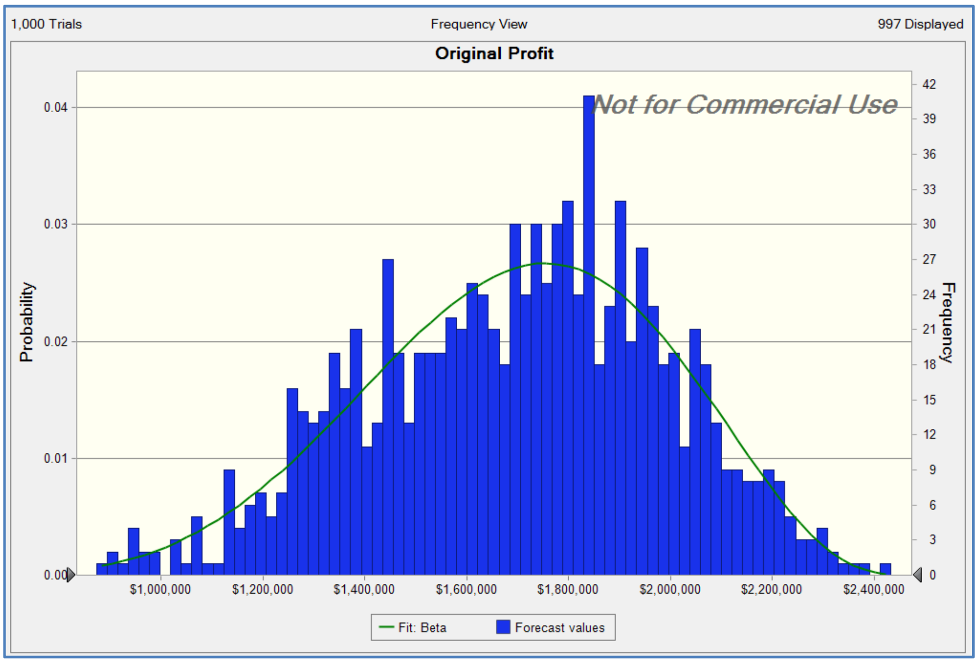
Risk analysis through the use of *Monte Carlo stochastic simulations* can be defined as the following:

> *Risk analysis or 'probabilistic simulation' based on the Monte-Carlo simulation technique is a methodology by which the uncertainty encompassing the main variables projected in a forecasting model is processed in order to estimate the impact of risk on the projected results*. (Savvides, 1994, p. 4)

Monte Carlo simulation incorporates the identified inputs that represent key risk and completes a large number of iterations to give a comprehensive probability distribution of the expected change in key project hurdle rates by changes in the key inputs (Savvides, 1994). In order to incorporate statistical validity, dynamic modelling of the outcome of key variables in conditions of uncertainty can be created using stochastic processes which seek to model the uncertainty in specific variables over time (PfnÜr & Armonat, 2013). Monte Carlo simulation iterations can be used when uncertainty is high in order to provide boundaries on the expected outcome of a variable. A property development project will create a complex set of cash-flows that are influenced by a number of risk factors, many of which will be correlated (Tziralis *et al*., 2009). This complexity can be addressed by using stochastic processes and estimation generated by Monte Carlo simulations (Baroni *et al*., 2006).

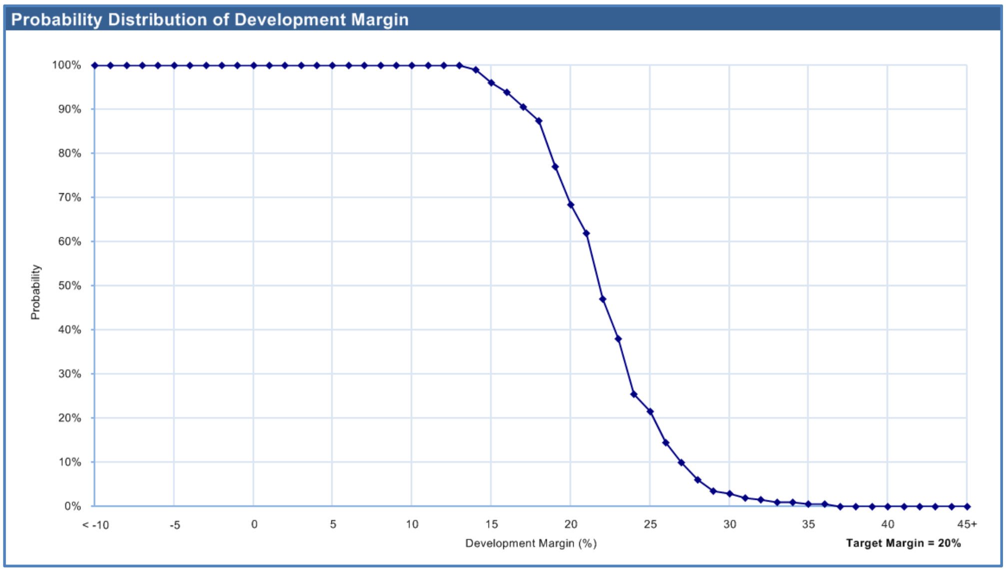
Monte Carlo simulations have been shown in the literature to be useful in estimating uncertain cash-flows and thereby land value in a development appraisal (Quigg, 1993; Li, 2000; Glicksman & Greden, 2005; Baroni *et al*., 2006). Historically, Monte Carlo simulations have not been not readily available in many of the proprietary feasibility analysis software programs and were usually found by installing Excel-based add-ins such as Oracle Software's Crystal Ball or Palisade Software's *@RISK* (Byrne, 2002; Havard, 2014; Atherton *et al*., 2008). In more recent times Argus Estate Master has added Monte Carlo simulations to their software platform. Figure 4.5.3b shows a Monte Carlo simulation of probabilities from Argus Estate Master's *DF* which likewise shows the probability.

Figure 4.5.3a: Monte-Carlo simulation of forecasted profit



Source: Author, 2018

Figure 4.5.3b: Argus Estate Master probability simulation



Source: Author, 2018

Figure 4.5.3a illustrates the use of Oracle software's *Crystal Ball* on a hypothetical development project that was originally presented in the scenario analysis in Table 4.5.2b in section 4.5.2 Scenario analysis. The probability distribution places the originally forecasted $1,903,765 profit as having the highest probability of being achieved but through the simulation of 1,000 stochastic processes calculated a series of probabilities around achieving a more pessimistic or optimistic outcome.

Figure 4.5.3a also indicates another important behavioural aspect of feasibility analysis in allowing the analyst to move away from a fixed-point feasibility model and to view potential outcomes in a broader sense as discussed in section 3.4.2. The historical use by developers of static single point development appraisal models, when the input variables determining the feasibility of a project contain a degree of uncertainty, can give a false sense of security where the analysis's margin of errors is not easily apparent (Atherton *et al*., 2008; Savvides, 1994). The use of Monte Carlo probability iterations allow for more traditional models to be modified to give the developer the ability to quantify the risks, and also allows moving from the idea of a best and worst estimate to a range of outcomes and a distribution (Byrne, 1995, 1996; French & Gabrielli, 2004, 2006; Loizou & French, 2012). Benefits that can be obtained through the use of this technique include gaining a better understanding of key project risks, measure the effect of risk events on the project outcome, quantify the probability of risk events and allow for a better comparison of potential projects (Savvides, 1994).

This research being undertaken for this thesis will attempt to ascertain the level of adoption of the various risk management analysis tools used by Australian property development firms. It is anticipated that, without ready access to such tools, the adoption of modern quantitative analysis techniques within the industry will have limited adoption.

4.5.4 Real Option Analysis

Real option theory is based on theoretical models that have been used in derivative markets since the founding of the Chicago Board Options Exchange (CBOE) in 1973. Real options are different from financial market options but are derived from the Black-Scholes option theory. The main area of difference is that financial options are based on a derivative of a security and a real option is based on a physical asset. Black & Scholes (1973) formulated the Black-Scholes option pricing model for valuing options on common stock that was then expanded upon by Merton (1976) to allow for dividend payments or regular income from an asset.

The Black-Scholes-Merton option model of valuing a derivative security requires five key pieces of information:

1. An asset value or price

2. A price at which the parties agree to exercise the option which is called the strike price
3. Option term (fixed time-frame)
4. A risk-free rate of return
5. Implied volatility of the underlying asset (Black & Scholes, 1973; Merton, 1976).

Financial option models assume a geometric Brownian motion or 'random walk', as described by Malkiel (1999), for an asset value with fixed volatility as a constant. By making an assumption about future risk or volatility, a prediction of the future value of an asset can be made (Teneng, 2011). Markets use these models to price derivatives, and the derivative pricing can be used to determine the probability of an asset achieving a target price by a given date. The subsequent addition of consistent revenue streams tied to the underlying Merton model allowed for regular dividends to form part of the valuation methodology. Later, Cukierman (1980), Greenley, Walsh and Young (1981) and Bernanke (1983) adapted option theory to the application of business management decision processes as a valuation methodology for a business or project. Any action a decision-maker makes that has the effect of adjusting a project's uncertainty and/or mitigate risk has an embedded real option (Schwartz and Trigeorgis, 2004). In Titman (1985) real option theory was further adapted as a means of valuation of the potential for a proposed project site or the flexibility of staging and or delaying commencement.

Further development of real option theory as applied to property development projects was developed by Williams (1993) to examine strategies to exercise call options on development projects in markets in equilibrium. Grenadier (1996) investigated market conditions where it is advantageous for developers to enter the market even in the face of high competition in a cascading strategy.

Grenadier found that in markets where demand volatility is high and is prone to market shocks have the highest levels of development concentration which may lead to dramatic market cycles. Often irrational levels of development can be explained by developers trying to anticipate well-forecasted increases in demand. The application of these findings highlights the increased risk to development projects the further out in time from the start of a demand cycle (Grenadier, 1996).

In the application of real option theory to property development decision making, the option to commence a development project is treated as the developer holding a call option over the site, the construction/development costs equalling the strike price and the finished building/s as the underlying asset (Leahy, 1993; Grenadier 1996).

Real options provide a framework for analysing the flexibility in development projects by analysing the decision maker's ability to adapt to uncertainty replicating a call option over an asset. A development site's value incorporates the potential of the site, and the feasibility of a project is dependent on both land use and density (Geltner *et al.*, 1996). The greater the degree of flexibility, the more a property developer is able to influence risk (Huchzermeier and Loch, 1998). Additionally, the type of product to be constructed, such as residential, commercial, industrial or retail real estate, is commonly referred to as a development parcel's *site usage* and the density refers to the intensity of the physical and economic activity of the project or a project's density yield. The potential for a change of use and the increase in density is equivalent to a call option over the site and was valued in models introduced by Williams (1991), Capozza and Li (1994) and Geltner *et al*. (1996).

The valuation of land has a much longer history in the literature including (Quigg, 1993) and (Sing & Patel, 2001). The application to the staging of more complex mixed-use development is more recent with academic literature producing many models including but not limited to the following:

- The use of decision trees in Kang (2004)
- Microsoft *Excel*-based models for complex property development projects by Hengels (2005), Barman and Nash (2007)
- The application of Monte Carlo simulations to real option theory for use in engineering projects including De Neufville *et al*. (2005), Cardin (2007)
- Cunningham (2006, 2007) found that increases in volatility of one standard deviation reduced development activity by 11.3%. This finding was repeated by Bulan, Mayer and Sommerville (2002) who examined 1,214 residential development projects in Canada and found and increases in systematic and idiosyncratic risk caused property developers to delay the commencement of projects

- Blind, Castello & Leishman (2011) applied real option theory to the Australian market in order to value development land in Western Australia
- Zhi and Sing (2017) found that stronger developers with lower marginal costs have the ability to exercise options much earlier in the cycle and therefore gain an advantage over weaker/smaller developers
- Mintah, Higgins & Callanan (2018) found that using real option theory in relation to the staging of development projects was able to represent project uncertainties to a higher degree of accuracy

> than would the use of a traditional DCF methodology. Additional findings suggest the staging of development projets offers decision-makers the option of abandoning unprofitable projects at several points and reduces unprofitable projects.

Over the last decade there have been numerous publications along this line, but most models proposed are complex and problematic to use in daily practice. As stated above, Hutchison *et al.* (2017) investigated the use of real option theory in decision-making by UK property development and investment firms finding no adoption of this technique. It is anticipated that there is an increasing divergence between academic theory and industry practice in relation to the application of real option theory in preliminary feasibility analysis (Barman & Nash 2007). This research aims to investigate the adoption and use of real option theory-based models in the go/no-go decisions of property developer's in the pre-commitment stages of the development process.

4.6 Summary

Within existing academic literature there remains a scarcity of understanding and analyses concerning the uptake and acceptance of the various risk measurement and mitigation techniques applied by property developers in the Australian markets. This research aims to investigate which techniques are being incorporated into the decision-making process during the pre-commitment stage of the development process and how property developers adjust their decision-making processes in light of a predicted change in project risk. The following chapter will examine the research methodology of this research and the key questions that will be addressed.

Chapter 5: Research Methods

5.1 Introduction

A review of relevant literature and past studies shows there exists a gap in knowledge regarding the selection and setting of hurdle rates and benchmarks for Australian real estate development projects in the pre-commitment stages of the development process. The primary focus of this research is to inform in relation to the gaps identified by gaining an understanding of the decision-making practices utilised within the development industry in Australia. In order to achieve the research objectives, it was essential to gain a comprehensive insight into two major attributes of current decision-making practices. Firstly, identifying the practices utilised in the industry, and secondly, to explore the reasons behind the choice of tools employed that aid decision-making under conditions of uncertainty.

5.2 Research objectives

A review of the current literature has identified a small number of studies that have sought to make a thorough survey of the practices used within the development industry. Surveys conducted include Newell and Steglick (2006), Civan (2007), Atherton *et al.* (2008), Costello & Preller (2010), Loizou & French (2012), Wiegelmann (2012), Coleman *et al.* (2012), Crosby *et al.* (2013), Garner (2011), Hutchison *et al.* (2017) and Crosby *et al.* (2018a & 2018b) outlined key decision hurdle rates and identified new practices that have been developed including the use of Monte-Carlo simulation and Bayesian models.

However, these studies did not identify the level of adoption or use of these methods within the development industry. Weigelmann (2012) analysed risk management within European development companies but did not fully examine how these models are used in decision-making processes. Other studies within Australia have been narrow in focus, surveying only one sector of the industry or one geographical area. For example, Preller (2009) surveyed Queensland residential developers, and Newell & Steglick (2006) sampled publicly-listed developers. There exists a gap in the literature examining the extent of the decision-making methodologies and the hurdle rates chosen as the go/no-go decision triggers by property developers in the pre-commitment stages of the development process. This research aims to broaden the knowledge base concerning the existing decision-making processes within development companies across industry sectors, ownership structure and company size.

5.3 Research design

Research in the social sciences is predominantly quantitative or qualitative in nature (Neuman, 2013). Quantitative research enquiry originates with a specific plan, a set of detailed questions and/or hypothesis followed by data collection from which the hypothesis can be sustained consisting of primarily numerical results from surveys, tests and experiments (Creswell & Creswell, 2017). The process of following this formula for carrying out quantitative research is referred to as *logical positivism* (Stainback & Stainback, 1988, p. 4). The gathering of quantitative empirical evidence using such a formula facilitated comparison of the decision tools used in feasibility analysis in the various sectors of the property industry and various company types. It also facilitated the testing and application, if any, of theory in praxis in the Australian property development industries.

Qualitative research is based on the philosophical orientation of phenomenology that focuses on people's experience from their individual perspective (Lewis, 2015; Collis & Hussey, 2013). Enquiry begins with a specific plan – a set of detailed questions about the area under investigation (Tashakkori & Teddlie, 2010). Qualitative research is more likely to incur bounded rationality due, in part, to a lack of information, experience, cognitive ability and impaired judgement. Quantitative research is less likely to demonstrate bounded rationality due to the survey design (Baxter & Jack, 2008). The use of qualitative methods in this research will allow for a deeper investigation into the existence of and/or causes of bounded rationality and heuristic decision tools within the feasibility analysis and development appraisal process.

Conducting *mixed methods* research involves the use of strands which represents those components of the study that encompass the basic process of conducting quantitative or qualitative research: posing a question, collecting data, analysing data, and interpreting results based on that data (Teddlie & Tashakkori, 2009). Mixed methods studies meeting the definition of mixed methods research include at least one quantitative strand and one qualitative strand (Johnson *et al*., 2007).

Quantitative and qualitative methods in research practice each exhibit distinctive strengths and weaknesses (Morgan, 2007). Mixed method design studies incorporate the use of quantitative and qualitative methods in a pre-determined and planned structure as part of the research process (Creswell & Clark, 2007). Tashakkori & Creswell (2007) advise the use of combining these two methods into a single study to allow the strengths of each method to be utilised and exploited while moderating and minimising the weaknesses inherent in the alternative research design. The methodological perspective on mixed methods holds that one cannot separate methods from the larger process of research of which it is a part. Any discussion of a mixed-method methodology 'should focus on the entire process of research, from the philosophical assumptions, through the questions, data collection, data analysis, and on the interpretation of findings' (Tashakkori & Creswell, 2007, p. 304).

Mixed methods research was defined by Tashakkori and Creswell (2007, p. 305) as follows:

> *Research on which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or program of enquiry.*

Greene (2007) expressed the view that the principal reason for combining methods using a mixed-method design allows the researcher to make sense of the world from multiple standpoints. In consideration of the need to minimise the weaknesses inherent in these types of research methods, the mixed methods design was adopted for this research. The rationale for adopting mixed methods design was outlined by Greene *et al.* (1989) to include triangulation, complementarity, development, initiation and expansion. Additionally, this research aims to 'assess trends and relationships with quantitative data but also be able to explain the mechanism or reasons behind the resultant trends' (Creswell & Clark, 2007, p. 82). In consideration of Bryman's (1988) findings regarding mixed methods design the reasons identified for the use of mixed methods in this research include the following:

- Completeness – refers to the notion that the researcher can bring together a more comprehensive account of the area of inquiry by using both quantitative and qualitative methods.

- Process – refers to when quantitative research provides an account of structures in social life, but qualitative research provides a sense of process.
- Explanation – refers to when one is used to help explain the findings generated by the other.

  (Bryman 1988, p. 105 – 107 as cited in Bryman 2017)

5.4 Survey design utilising mixed methods in parallel

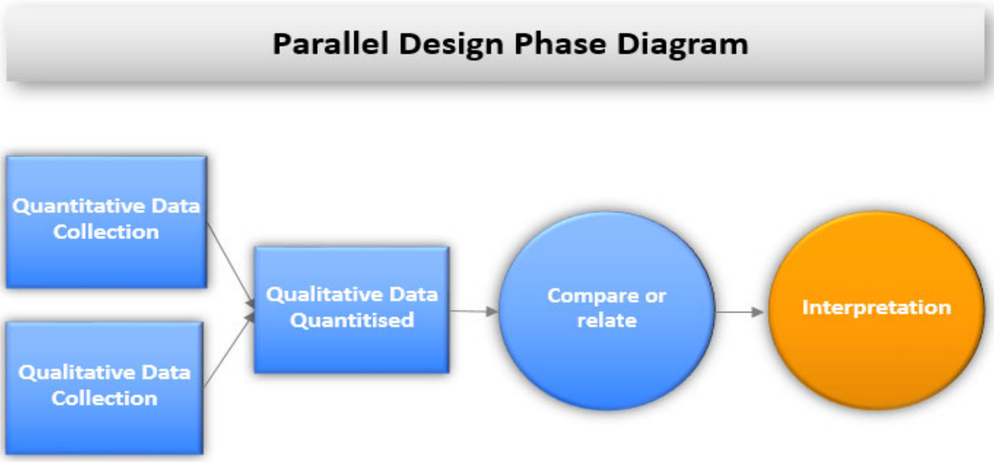
The choice of research design for this thesis was originally a mixed-method explanatory sequential design where a quantitative survey would be conducted then followed up with qualitative interviews. Explanatory sequential design typically occurs in two distinct interactive phases and involves the use of both post-positivist and constructivist paradigm foundations (Creswell & Clark, 2007, p. 121). *Explanatory sequential design* uses sequential implementation commencing with quantitative (or qualitative) data collection and analysis in phase one followed by qualitative (or quantitative) data collection and analysis in phase two. The results of the quantitative strand are used to make decisions about qualitative research questions, sampling, data collection and participant selection in the second qualitative phase. The primary point of interface for mixing is at data collection, and a quantitative emphasis on the strands subsists.

The research design was later refined to allow for a *parallel mixed method* design to be conducted through a single survey rather than through a mixed-mode instrumental approach to take advantage of the strengths of a combined instrument (Curran & Blackburn, 2001). The rationale for the change in methodology was based on three primary reasons. First, by having quantitative questions to be immediately followed by qualitative questions allowed participants to respond to questions regarding demographic characteristics of the property development organisation and the decision-makers within those organisations, hurdle rate selection and usage and then be allowed to immediately reflect or give a reason for their choice of hurdle rate in a qualitative open-ended answer. Second, the use of parallel strands within the same instrument allowed for a much larger sample of qualitative responses that could reasonably be obtained through other qualitative data collection methods such as interviews, focus groups or the Delphi technique. Third, the use of a parallel survey allowed for a far larger reach in both geographic terms and industry scope than would have been practical using primarily qualitative data collection approaches. A limitation to the combined strands in one survey instrument included allowing a significant amount of time for respondents to complete the survey. This aspect was addressed in the pilot test survey.

Figure 5.1 illustrates the research design which includes the quantitative and qualitative data strands being collected in a single-mode instrument. Where possible the qualitative data is analysed and *quantitised* into codes that can be analysed statistically with the quantitative data (Saunders *et al*., 2009). The final step in the process is to compare and relate the two types of data collected and then interpret the results (Cresswell, 2014).

This research was conducted by implementing the strands in two distinct phases. First, a pilot study was administered to collect data and feedback on the research design that then was used to influence the design of the second strand which includes a quantitative survey as well as open-ended questions that were more qualitative in nature. The initial quantitative section of the survey gave a snapshot of the current practices within the Australian development industries including the use and choice of hurdle rates and benchmarks in decision processes during the pre-commitment stage of the development process.

Figure 5.1: Parallel design methodology



Source: Adapted from Creswell (2014, p. 220) and Saunders *et al*. (2009, p. 152)

5.4.1 Phase 1 – a pilot test of the survey

The first phase of the research included the design and implementation of a survey pre-test which was conducted to assess the viability and practicality of the survey design. Prior to formal pre-testing, potential survey questions were subjected to cognitive testing as described by Beatty & Willis (2007) to assess the measurability of questions and eliminate problems in survey design prior formally collection of data.

Approximately 20 industry practitioners and academics working in related fields tested draft versions of the survey, and their feedback was incorporated into subsequent versions. The purpose of a pre-test is to gauge the effectiveness of a surveys design and test the data collection protocols in realistic conditions (Fowler Jr, 2013). The pre-test sought to provide clarification on issues including time to complete the survey, verification of the questions, pre-set answers and the flow of questions given the different path the survey can take depending on the choices made in the decision tree.

The pilot test resulted in a number of pathway problems within the decision structure of the survey, allowing for rectification. Additionally, the pilot test highlighted a concern from industry participants in relation to the disclosure of project-specific financial information and outcomes as this could be a violation of common workplace confidentiality agreements generally prevalent in the industry. Taking into consideration the desired sample size and the primary research focus to uncover decision and hurdle rate selection practices, specific project financial disclosure was omitted from the final survey. The pre-test also confirmed that a motivated respondent would be able to complete the questionnaire in 15 to 25 minutes depending on which sections needed completing.

This initial phase of the research generated a comprehensive review of the tools currently being employed in the industry and allowed for a comparison to the past in order to help understand the evolution of feasibility analysis. The postpositivist paradigm foundation utilised in phase one allowed the research to make claims for knowledge based on four areas as identified by Slife & Williams (1995).

- Determinism or cause-and-effect thinking
- Reductionism by narrowing and focusing on selected variables to interrelate
- Detailed observations and measures of variables
- The testing of theories that are continually refined.

5.4.2 Phase Two - a quantitative and qualitative survey

The phase two strand of the research incorporated a survey which included both quantitative and qualitative questions that were given to industry decision-makers involved in the pre-commitment go/no-go decision-making process within the overarching development process. The purpose of this survey was to gain an understanding of the key feasibility analysis decision matrix being incorporated and applied. The empirical data generated from the survey provided insight into the practices being used by property development organisations, as there is very little research demonstrating how different sectors of the industry select and incorporate hurdle rates into the pre-commitment stages. In addition to the property type, the survey allowed for an examination based on company type being public or private, as well as, investigating the difference in the size of the development company and the ownership structure used, for example, the speculative developer or property investors/developer.

An understanding of current practice facilitates answering research questions about bounded rationality and what heuristic models and/or rules of thumb are currently being applied. Additionally, phase two of the research provided a sector by sector analysis of the property development industry, which to the author's knowledge, has not been undertaken to differentiate the models used by residential, industrial, commercial, retail, infrastructure, tourism and mixed-use developers. The post-positivist paradigm foundation adopted in phase two allowed for 'the progression from theory to hypotheses to data; to add or contradict theory' (Creswell & Clark, 2007, p. 40).

Additionally, within the second phase of the research qualitative open-ended questions allowed participants to expand upon the methods used to determine project viability and assess the risk of a project. The purpose of the qualitative questions was to look for where key industry stakeholders and decision-makers believe their models can be improved and where they see the decision-making process leading to in the future.

In the survey instrument, qualitative questions based on constructivism were adopted to gain an understanding or meaning of phenomena through the participant's subjective views. Researching from the bottom up to understand individual perspectives that lead to identifying broad patterns and then ultimately coming to broad understandings (Creswell & Clark, 2007). Bryman (2006, p. 99) identified the three main methodological challenges presented by using a qualitative approach to collecting data which included the following:

> *Gathering enough data to address the research question, dealing with the enormous quantity of qualitative data that results from a thorough investigation and sorting and interpreting data to give meaning. (Bryman, 2006, p. 99)*

'Qualitative and quantitative approaches in a single study complement each other by providing results with greater breadth and depth' (Roberts, 2010, p. 145). Combining findings with supported reasoning adds strength and detail to the explanation of the data. Quantitative methods will be used 'to summarise large amounts of data and reach generalisations based on statistical projections' (Roberts, 2010, p. 145). The qualitative research derived input from the participant's point of view and provides a more detailed description than what is possible through a quantitative instrument alone (Roberts, 2010).

5.5 Sample selection

Sampling as a process is defined by Kumar and Phrommathed (2005, p. 164) as:

> *The process of selecting a sample from the sampling population which will work to become the basis for estimating or predicting the prevalence of an unknown piece of information, situation or outcome of the larger population.*

The credibility of a study relies on the quality of the procedures used to select the sample and determines the generalisability of the research findings. Sampling can be guided by the following three principles:

1. In the sampling process, there will be a difference between the sample statistics and the true population mean which is attributable to the selection of units in the sample.
2. The greater the sample size, the more accurate will be the estimate of the true population.
3. The greater the difference in the variable under study, the greater will be the difference between the sample statistics and the true population mean. (Yin, 2017; Kumar & Phrommathed, 2005)

The use of a mixed-method design requires the researcher to consider the sampling principles for both the quantitative and qualitative strands (Koerber & McMichaels, 2008). Qualitative research is most often concerned with achieving forms of generalisability or transferability whereas quantitative research strives to be statistically representative of the total population (Kumar & Phrommathed, 2005). The steps in sampling apply to both quantitative and qualitative research. However, there exist fundamental differences in how they are addressed, specifically regarding the sampling approach and the sample size (Creswell & Clark, 2007).

Kumar (2016) advises the use of purposive sampling when research aims to describe a phenomenon or develop something about which little is known. Here the primary factor is the researcher making judgements to identify who can provide the best information to accomplish the objectives of the research. Research is focused on those individuals selected who are likely to have the required information and be willing to share it. May (2002) advised that an opportunistic sampling strategy is not appropriate in qualitative strands, but rather the sample needs to relate in some systematic manner to the social world and phenomena that the study seeks to enlighten. Here the criterion most commonly proposed for sampling is diversity, where researchers seek to recruit 'participants who represent a variety of positions in relation to the research topic, of a kind that might be expected to throw light on meaningful differences in experience' (King & Horrocks, 2010, p. 29).

In consideration of the literature, non-random probability sampling methods adopting quota and homogenous sampling methods were adopted. The terms purposeful and theoretical sampling are often defined synonymously and used interchangeably in many research studies (Coyne, 1997; Charmaz & Belgrave, 2015). *Purposeful sampling* in quantitative and qualitative research means that 'researchers intentionally select participants who have experienced the central phenomenon or key concept being explored in the study' (Creswell & Clark, 2007, p. 173).

Homogenous sampling involves studying individuals who have membership in a subgroup with distinctive characteristics (Patton, 2005; Teddlie & Yu, 2007). Both homogeneous and purposeful sampling were applied to this research by approaching decision-makers within property development companies as a basis of selection to be participants in the survey. As both the sample size and population are small, stratified sampling will further improve the analysis of the data collected. The sample population was stratified along the following basis:

- Geographic areas including New Zealand, South-East Queensland, Northern-Queensland, Sydney, Melbourne, Adelaide, Canberra, Darwin and Perth
- Property type including residential, commercial, retail, industrial, tourism, aged care, childcare and mixed-use development
- Size – large, medium-large, medium-small and small developers as discussed in Chapter 2 (Note: in some statistical analysis in Chapter 6 the large and medium-large categories are condensed)
- Developer motive – speculative developer and developer/investor
- Company type - publicly listed versus private ownership
- Specialised versus diversified developers

5.6 Population

The population consisted of decision-makers within property development companies that conduct development appraisal and feasibility analysis to determine the viability of a potential project, as well as the site acquisition in the pre-commitment stages of the development process. There is a significant emphasis in this research on the Australian property development industry, but as property developers are becoming increasingly international, other geographical areas were also included (Squires & Heurkens, 2016). The population of decision-makers is unknown and an estimate determined by evaluating the client sizes of leading proprietary feasibility software companies and allowing for at least 50% industry use of bespoke models gives a population of approximately 3,000 development companies within Australia, with an unknown number of decision makers. 2013 ABS data for the category of Land Subdivision and Development included 907 development companies having an annual turnover greater than $2 million (ABS, 2013). The reliability of this information is questionable, as many property developers have a construction division and may be listed in the Construction categories within the ABS data.

The phase two strand of the research achieved a sample size of 225. Achieving the sample size desired necessitated the assistance of industry organisations such as Estate Master, now owned by Altus Group, which assisted with the distribution of the survey to property developers at training sessions and facilitated in the collection of 38 surveys or approximately 21% of the 225 total responses. Additionally, participants were purposefully sampled by utilising the author's contacts, searching via LinkedIn Premium and through attending property industry events. The purposeful sampling was both highly selective and labour intensive, contributing to the nine-month time frame for data collection. Each of the potential participants received either a covering letter or a landing page that outlined the following information:

- Purpose of the research and the aims sought from the research project
- Who was conducting the research and how to get in contact with the researcher
- An explanation of the ethics approval and how to contact the University if they have any questions or complaints
- A statement on participant confidentiality and the right to withdrawal without jeopardy
- An estimate as to the amount of time required to complete the survey instrument
- Instructions for completing the survey instrument,
- A consent form for participating in the research.

5.7 Instrumentation

The research instrument includes the mechanism for the collection of data and needs to be appropriate in terms of both validity and reliability. *Validity* is the degree to which the instrument accurately measures the variables that were intended to be measured. *Reliability*, is where 'the degree to which the instrumentation consistently measures a variable and is repeated over multiple periods' (Roberts, 2010, p. 152). The design of the survey instrument included questions with response categories including rating scales, checklists and ranking, as well as open-ended questions to allow participants to provide subjective interpretation. The initial questions in the survey were used to determine consent to participation in the research project and also to qualify respondents that they are involved in the decision-making process of selecting and acquiring property development projects. Within the online survey instrumentation, potential respondents that did not meet the minimum qualifier requirements were thanked for their time and were not permitted to begin the survey questions. This qualifying question was designed to minimise the potential of recording responses that would not be meaningful to the results of the research project.

The instrumentation of the survey was administered in two different formats during the period of October 2015 to June 2016. The first was an online survey facilitated by the Qualtrics Survey Platform where 187 respondents completed the survey. The second method was a paper form that was given out at Estate Master training sessions (as described above) where 38 respondents completed and submitted the written survey. First, the survey instrument included demographic questions designed to measure characteristics of decision-makers and the organisation in which they are employed. These included questions regarding geography, experience, educational level, job-role, organisational structure, developer type, property types developed, project size and developer motive. Second, respondents were asked questions regarding their organisation's decision structure and project selection including the specific hurdle rates utilised, the choice of financial metrics for project evaluation, the methods of changing project hurdle rates and structural issues in the decision process. Third, participants were asked about their practices regarding the mechanics of feasibility analysis including the tools utilised to determine project viability as well as what variables are forecasted. Fourth, respondents were asked questions regarding common risk analysis methods used in industry including attributes and their perception of risk tolerance/aversion.

5.8 Efforts to increase the response rate

Strategies adopted to increase the instrument response rate included the following methods:

- Preparation of the explanatory statement and landing page described above. This letter gave potential participants an overview of the research objectives and the value and benefits that potentially could be derived from the completed project.

- A prize inducement offer that gave participants the possibility of winning an Apple Ipad. The respondents had the option of opting into the prize draw. The prize draw was administered by a representative of the Office of Research Services at Bond University in accordance with the approved Human Research Ethics Committee at Bond University ethics application number 15151. One respondent was drawn out and had their prize delivered by registered mail.

- Two weeks after initial contact, potential participants received one follow up email or call to ask if they would complete the survey instrument. Potential participants were also asked if they had any questions regarding the research or had any difficulty while completing the survey. The online survey was available on either a website via a PC or through their smart-phone or tablet device.

The strategies to increase the survey response rate were effective in achieving 225 responses out of the 437 property developers approached leading to an overall response rate of 51.5%. This result is particularly positive as surveys of property development organisations have generally had low response rates. The response rate and the composition of respondents in the survey will be discussed further in section 6.1.

5.9 Research questions

A primary aim of this research was to explore the various decision methods used, identify their level of use and the importance of each method to different sectors of the industry. Additionally, this research aimed to make a contribution to inform regarding the gaps within the literature and other prior studies. The research questions were designed to address each of the research aims, originating from both the literature review and the author's experience in the field and are listed as follows:

5.9.1 Research Aim 1:

Determine the role of feasibility analysis and development appraisals in management decision-making, the use of hurdle rate methodologies and forecasting practices, building on decision theory and value management knowledge frameworks. Does theory provide insights into the role of feasibility analysis with new projects?

- **RQ 1:** Australian property development firms use of specific go/no-go hurdle rate mechanisms as a decision basis

    a. Do Australian property development firms use specific go/no-go hurdle rate mechanisms as a decision basis for proceeding beyond the pre-commitment stages of the development process?

    b. What are the specific hurdle rates and benchmarks which are currently being used by Australian property development firms?

- **RQ 2:** What are the differences in the hurdle rates and benchmarks selection as the basis of go/no-go decisions based on the following factors:

    a. Projects by property types including residential, commercial, retail, industrial, retirement, infrastructure and mixed-use projects?

    b. Projects by development company size and ownership? Publicly listed and private development companies? Large, medium-large, medium-small or small projects?

    c. Projects by developer motive? Speculative or trader developers versus develop and hold/investor developers?

    d. Does experience influence hurdle rate selection? Test differences between experienced versus novice decision-makers.

e. Do decision makers with a specific property-related degree differ in hurdle rate selection and use?

f. Are there significant differences in hurdle rate selection and use between different geographic regions of Australia and New Zealand?

- **RQ 3:** Do organisations and decision-makers that utilise proprietary feasibility programs differ in their feasibility practices and selection and use of hurdle rates from those which use Microsoft Excel or create their own feasibility program?

- **RQ 4:** Do Australian development companies use the residual land value method, discounted cash-flow method, residual accumulation cash flow method and/or market comparison method for determining a potential development site's value in the pre-commitment stages of the property development process?

5.9.2 Research Aim 2:

Examine the relationship between bounded rationality, heuristic bias and management decision-making in the presence of volatile externalities with a view to measuring the extent of variable interdependence over time.

- **RQ 5:** Development company processes and methods for altering and adapting hurdle rates and benchmarks.

a. Do development companies have a pre-determined process and method of altering or adapting the chosen hurdle rates and benchmarks?

b. How do Australian property development organisations specify and change the required hurdle rates and benchmarks as a basis of go/no-go decisions in light of increased risk and uncertainty?

- **RQ 6:** Do development companies demonstrate bounded rationality in their decision-making processes?

5.9.3 Research Aim 3:

Consider the use of Monte Carlo simulations, Bayesian models and option theory, real and embedded options in long-term property development and investment decision making as instruments for providing flexibility and managing risk, uncertainty and change.

- **RQ 7:** Australian property development companies use of sophisticated theory led structured quantitative analysis in the feasibility models used in their decision-making processes in the pre-commitment stages of the development process.

a. **RQ 7a**: Do Australian property development companies use sophisticated theory led structured quantitative analysis in the feasibility models used in the decision-making processes in the pre-commitment stages of the development process?

b. **RQ 7b**: Do Australian development firms use Monte Carlo simulations, Bayesian models, and/or option theory to aid decision-making?

- **RQ 8:** Are Australian property development companies confident in their organisation's risk identification and management practices in the decision-making processes of the pre-commitment stages of the development process?

In order to accomplish the research aims and address the research questions, it was necessary to gather empirical evidence regarding the current practices used within the major property sectors and company types within the Australian property development industries. This empirical quantitative data was useful in making comparisons between the theoretical models and processes and actual industry practice. Table 5.1 summarises the key research aims, questions and hypotheses that were tested in the phase two research strand.

Table 5.1: Summary of research aims and questions

TITLE	Feasibility Analysis in the Pre-Commitment Stages of the Development Process
DESCRIPTION	An examination of uncertainty, risk and heuristic bias in management decision making processes during the pre-commitment stages of the real estate development process in Australia
RESEARCH AIM	A primary aim of this research was to explore the various decision methods used, identify their level of use and the importance of each method to different sectors of the industry. The research questions were designed to address each of the research aims, originating from both the literature review and the author's experience in the field and are listed as follows:
AIM 1	Determine the role of feasibility analysis and development appraisals in management decision-making, the use of hurdle rate methodologies and forecasting practices, building on decision theory and value management knowledge frameworks. Does theory provide insights into the role of feasibility analysis with new projects?
RQ1	Australian property development firms use of specific go/no-go hurdle rates mechanisms as a decision basis for proceeding beyond the pre-commitment stages of the development process.
RQ 1a	Do Australian property development firms use specific go/no-go hurdle rates mechanisms as a decision basis for proceeding beyond the pre-commitment stages of the development process?

RQ 1b	And if so, which hurdle rates and benchmarks are currently being used by Australian development firms.
RQ2	What are the differences in the hurdle rates and benchmarks selection as the basis of go/no-go decisions based on the following factors:
RQ 2a	Projects by industry types including residential, commercial, retail, industrial, retirement, infrastructure and mixed-use projects?
RQ 2b	Projects by development company size and ownership? Publicly listed and private development companies? Large, medium-large, medium-small or small projects?
RQ 2c	Projects by developer motive? Speculative or trader developers versus develop and hold/investor developers?
RQ 2d	Does experience influence hurdle rate selection? Test differences between experienced verses novice decision-makers.
RQ 2e	Do decision-makers with a specific property-related degree differ in hurdle rate selection and use?
RQ 2f	Do significant differences in hurdle rate selection and use between different geographic regions of Australia and New Zealand?
RQ 3	Do organisations and decision-makers that utilise proprietary feasibility programs differ in their feasibility practices and selection and use of hurdle rates from those which use Microsoft Excel or create their own feasibility program?
RQ 4	Do Australian development companies use the residual land value method, discounted cash-flow method, residual accumulation cash flow method and/or market comparison method for determining a potential development site's value in the pre-commitment stages of the property development process?
AIM 2	Examine the relationship between bounded rationality, heuristic bias and management decision-making in the presence of volatile externalities with a view to measuring the extent of variable interdependence over time.
RQ5a	Do development companies have a pre-determined process and method of altering or adapting the chosen hurdle rates and benchmarks?
RQ5b	How do Australian property development organisations specify and change the required hurdle rates and benchmarks as a basis of go/no-go decisions in light of increased risk and uncertainty?
RQ6	Do development companies demonstrate bounded rationality in their decision-making processes?

AIM 3	Consider the use of Monte Carlo simulations, Bayesian models and option theory, real and embedded options in long-term property development and investment decision making as instruments for providing flexibility and managing risk, uncertainty and change.
RQ7	Australian property development companies use of sophisticated theory led structured quantitative analysis in the feasibility models used in their decision-making processes in the pre-commitment stages of the development process.
RQ 7a	Do Australian property development companies use sophisticated theory led structured quantitative analysis in the feasibility models used in the decision-making processes in the pre-commitment stages of the development process?
RQ 7b	Do Australian development firms use Monte Carlo simulations, Bayesian models, and/or option theory to aid decision-making?
RQ8	Are Australian property development companies confident in their organisation's risk identification and management practices in the decision-making processes of the pre-commitment stages of the development process?

5.11 Data analysis

The questions within the survey instrument were carefully designed to address the research questions and hypothesis listed above. According to Yin (2003, p. 42) 'data analysis consists of examining, categorising, tabulating, testing, or otherwise combining both quantitative and qualitative evidence to address the initial propositions of the study'. The data collected via the survey instrument was analysed with the use of Microsoft Excel, Qualtrics Survey Platform, Salford Software CART and the Statistical Package for Social Sciences (SPSS) version 25. The research questions were addressed through the use of statistical tests including factor analysis, decision trees, artificial neural networks, binary and multivariate regression analysis and non-parametric techniques which are summarised in the following sections.

5.11.1 Non-Parametric models and Recursive Partitioning models

The analysis of the data from the phase two survey strand of the research used both parametric and non-parametric statistical techniques. *Parametric tests* are designed to make an 'assumption about the population from which the sample has been drawn' (Pallant, 2011, p. 213). Parametric tests also often require an assumption regarding the existence of a normal distribution in the dispersion of the data in question (Kothari, 2017). This technique is useful with data variables represented as continuous numbers where the distance between numbers has a specific meaning and value. An example of a continuous data variable from this research where the distance between numbers is meaningful is when respondents indicated the specific IRR percentage they use as a minimum financial metric hurdle rate for project selection. The distance between 18% and 19% is meaningful and can be measured. However, an example of a data variable for which the distance between numbers is not equally meaningful would be the use of a Likert scale where respondents indicated their confidence in their organisation to identify project risks. When using Likert scales and categorical data non-parametric tests are preferable (Norman, 2010).

Non-parametric techniques do not place the same demands for the distribution of the data but do have the requirements of random samples and independent observations. Additionally, this technique is useful when data is measured in nominal and ordinal ranked scales as well as categorical variables (Pallant, 2011). Additionally, non-parametric techniques make no assumptions about the population from which the sample has been drawn. Examples of non-parametric tests used in this research include tests of independent samples such as the Pearson Chi-Square test, the Mann-Whitney U test and the Kruskal-Wallis analysis of variance (ANOVA).

The *Pearson Chi-square* test of independence is 'used when you wish to explore the relationship between two categorical variables' (Pallant, 2011, p 217). Chi-square tests are useful in determining if there is a statistically significant association between two variables, but this technique cannot be used as a predictor of a variable. The primary use of Chi-square tests in this research was as a preliminary search for statistically significant associations between variables that were then further investigated with other techniques.

Mann-Whitney U Test is useful for examining the differences between two independent groups on a continuous measure and is the 'non-parametric alternative to the t-test for independent samples' (Pallant, 2016, p. 227). An advantage of this technique when grouping data by a categorical variable is the examination of median values rather than a mean. This statistical technique was used extensively in this research to analyse the various grouping of developers against criteria such as hurdle rate selection and use. The *Kruskal-Wallis Test* is the non-parametric alternative to a one-way ANOVA between groups, and also allows for comparison of scores on continuous variables across three or more groups (Pallant, 2011).

The use of recursive partitioning is a statistical method that can be used to conduct multivariate analysis. *Recursive partitioning* models as a statistical technique provide a substitute to and often a superior outcome to traditional parametric regression models by dividing data sets into groups based on the relationships of nodes (Zhang & Singer, 2010). Examples of techniques that use recursive partitioning models include Stochastic Gradient Boosting, Classification and Regression Trees (CART) and Decision Trees including Random Forests (Halteh *et al.*, 2018). Halteh *et al.* (2018, p. 5) cited Gepp (2015) stating that the increasing popularity and use of non-parametric models can be explained as:

> *Due to their recent invention—relative to parametric models—they are naturally less occurrent in the literature, however, they are slowly gaining traction due to their superior predictive capabilities.*

5.11.2 Decision Trees

Decision Trees (DT) (sometimes referred to as classification trees) are binary trees that split pre-defined categorical data into two groups (Gepp *et al*., 2012) DT is a stochastic statistical technique that runs repeated iterations of splitting variables into two categories given a set of defined splitting rules. ‘DTs offer an easy to interpret and implement non-parametric model that still has the power of a multivariate approach and is able to model interactions between variables’ (Gepp *et al*., 2002, p. 553). A major advantage in the use of DT is that the statistical technique is non-parametric, which removes the requirement of not violating the distribution assumptions. DTs are also able to ‘handle missing values and qualitative data, as well as easily be represented in a graphical format’ (Kumar *et al*., 2010). DTs are used within the statistical analysis of this research to make predictions of independent variables given a dependent variable and also are used to inform which variables should be used in binary and multinomial linear regression.

5.11.3 Artificial Neural Networks

Artificial Neural Networks or ANNs are based on the biological networks that exist within the human brain and were introduced by Mculloch and Pitts (1943). ANNs were later shown to have been a useful technique for testing the relationship between independent variables (Lippmann, 1987; Demyanyk & Hasan, 2010). ANNs have also been shown as a valuable technique for predicting variables when there are many groups (Lapedes & Farber, 1987), and also as a predictor of commercial property values (Connellan & Howard, 1998). ANN analysis using Multilayer Perceptron is used within this research to determine key differences among respondent attributes, and specifically in relation to predictors of hurdle rate selection.

5.11.4 Logistic regression – binary and multinomial

Logistic regression (LR) in both binary and multinomial calculations allow for the use of categorical dependent variables and is often used in literature when dealing with firm decision models (Cybinski, 1995). Additionally, this statistical method is being used more frequently in recent times as it often produces superior results to traditional regression methods when describing the relationship between response variables and one or more explanatory variables (Hosmer *et al*., 2013). The binary form is used to predict a categorical variable with only two possible outcomes. The multinomial form of LR is used when there are more than two possible outcomes (Anderson *et al*., 2008). In statistics, logistic regression can be used as a classification method in order to fit categorical data to a logistic function. “It is used for predicting the outcome of a categorical criterion variable based on one or more predictor (independent or explanatory) variables” (Liu & Liang, 2014, p. 197). Another advantage of logistic regression is the removal of the requirement of the assumption of normality and linearity within the distribution of independent variables that is present in discriminant based linear regression. Logistical regression was used to predict the classification of the dependent variable in testing the null hypotheses described in section 5.11.

5.12 Research Limitations

Limitations are factors that prevent findings being claimed as true for all people in all times and places (Roberts, 2010). A *limitation* can be defined as a ‘systematic bias that the researcher did not or could not control and which could inappropriately affect the results' (Price & Murnan, 2004, p. 65). For the quantitative study, these are the factors that limit generalisation. For the qualitative study, these are the factors that limit the relevance of the study to other populations or individuals (Roberts, 2010). '*Generalisation* means the sample results accurately represent the results of what you would get if you were able to assess the entire target population' (Price & Murnan, 2004, p. 65). Also, a 'study design must be internally valid to be externally valid and to produce accurate findings' (Fink, 2003, p. 60).

Examples of typical limitations include 'sample size, methodology constraints, length of the study and the response rate' (Roberts, 2010, p. 163). An example from this research where generalisation may not be possible includes the fact that respondents were primarily Australian property developers and the results of the analysis may not be applicable in other geographic areas. However, as discussed in Chapters 3 and 4, the results of surveys of property development organisations of other regions have demonstrated a common approach to decision-making and hurdle rate selection across multiple nations.

It is necessary to establish limits and parameters defining the boundaries of the research. An important difference between the public and private development market is the criteria used to measure performance with public projects valued against time and cost performance benchmarks and the economics determined, *prima facie*, on the social rate of return (Campbell, 2003). This research is primarily focused on the go/no-go decision making hurdle rates incorporated in speculative based development projects and limits the participants to be decision-makers and/or development companies whose activities and primary reason for undertaking development projects is to derive maximum economic gain/profit as determined by the theoretical principle of highest and best use. For this reason, purposeful sampling was adopted and through the qualifying questions with the requirement of respondent property development organisations having, and using, pre-determined financial metrics for project selection and the determination of the go/no-go decision.

There exist several additional significant questions regarding property development and development projects as to whether they should proceed or not proceed which are not based on economic profit. These additional considerations may include the project's impact on environmental, social, public benefit, longevity and macroeconomic aspects and particularly the relationship between development and the business and property cycles (Wilkinson *et al.*, 2015). Each of these considerations is important in its own right and may impact the decision to proceed as well as answer ethical questions regarding if a project is the best-suited development scheme to benefit society. As important as these considerations are, they are not the primary focus of this research which, in principle, is focused on looking at how uncertainty is addressed by businesses in the pre-commitment development appraisal stage of the overall property development process discussed in Chapter 2.

Results of the study will also be limited to the demographic characteristic of the respondent organisations including the types of property developed, the developer typologies discussed in Chapter 2, the ownership structure of the respondent organisations as well as the distinct geographical areas of operation of the participants in the study. However, it is anticipated that the results will give rise to a better understanding of how the decision-making processes of property development organisations, in choosing to commence projects, has changed as a result of the GFC and how different property types and/or development objectives give rise to different priorities or hurdle rates in the decision process.

This research makes no attempt to develop a universal model or recommendation of the best method for project evaluation or of the optimal rate to be chosen. However, insights into the evolution of the decision-making processes of successful developers and property investors may provide lessons for wider application. The investigation of uncertainty and forecasting in decision-making processes in complex development and investment projects gives rise to a large number of dependent and independent variables so that it is not possible to fully investigate them all. Investigation of macro and microeconomic factors, including the impact of severe supply restrictions in property markets within Australia, which influence the property and/or real estate market have only been considered at the secondary level. It is considered that an independent examination of these factors would not lead to a significantly better decision-making process.

This study has attempted to identify the key decision-making processes and hurdle rates used in development companies and within a number of geographic locations within Australia and New Zealand, but may not be representative of all development companies within these nations. A number of different types of property development projects have been investigated including residential land subdivision, residential built form, office, retail, industrial, tourism and mixed-use, and it is recognised that this may not be indicative for all forms of property development projects.

The survey instrumentation was based on a purposeful sample of data that was cross-sectional in nature and conducted over a specific period of time. Additionally, the survey instrument is limited to the self-reported perceptions, beliefs and experiences of decision-makers within property development organisations who primarily conduct projects in Australia. Furthermore, approximately 15% of the survey responses received were sourced by Argus

Estate Master at a feasibility analysis training event. Although, these specific responses did not demonstrate any significant statistical difference in response to their choice, usage or alteration of hurdle rates in relation to the 85% of responses sourced from other means (See Appendix G). Therefore, the possibility exists of bias by research participants because of their employment within the property development industry and/or their participation in an Argus Estate Master Training event. A particular area that may incur bias is in the traditional methods of decision-making and hurdle rate selection that have long been established rules of thumb. The survey respondents were also self-selecting and were required to demonstrate their willingness to participate in the research in the qualifying questions.

5.13 Summary

The purpose of this chapter was to provide an overview of the research aims, objectives and the methodology adopted in the design of this thesis to address the research questions. A parallel mixed method design methodology was adopted to undertake the data collection and analysis in a single-mode survey instrument. The literature review conducted in Chapters 2, 3 and 4 demonstrated that there has been limited research conducted outlining the hurdle rate selection and decision processes used by property developers in the pre-commitment stages of the development process. The research methodology and design was chosen in order to gain insights into property developers selection and use of hurdle rates in decision-making and how these are adjusted or adapted in the presence of a perceived change in risk or uncertainty.

Chapter 6 presents the results of the empirical survey, a summary of the demographic characteristics of the survey respondents and the findings of the statistical analysis used to address the research areas and specific questions.

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Chapter 6: Results and Analysis

As identified in Chapter 1, the primary aim of this research is to examine the feasibility analysis decision-making practices of real estate development firms in Australia and obtain information regarding hurdle rate selection and techniques commonly utilised to determine project viability. It is common practice for decision-makers to use generic hurdle rates and industry rules of thumb and benchmarks when deciding to proceed with a project in the pre-commitment stages of the property development process (Diaz III, 2010; Sah *et al*., 2010; Rowley *et al*., 2014; Crosby *et al*., 2018a). The *pre-commitment stages* refer to the stages in the development process prior to a go/no-go decision point and before site acquisition or project commencement. It is this point in the development process that marks a key milestone where significant capital must be committed to the project.

It is important to ascertain which hurdle rates are currently being used by industry, and what are the minimum financial metrics incorporated into decision processes. Hurdle rate selection is commonly believed to include an allowance for the developer's cost of capital over time as well as a premium commensurate with a subjective assessment of a project's unsystematic risk (Sharpe, 1964). This research examines the current levels of specific hurdle rates being utilised by industry participants and also seeks insight into how hurdle rates are modified given a perceived change in the risk and uncertainty in a potential project.

This chapter presents the findings of the empirical survey phase of the research design containing the results of both the quantitative and qualitative questions.

Survey question response rates and descriptive statistics demonstrating the characteristics of the sample are outlined below. This chapter has been structured on the basis of describing the demographic characteristics of participants in the empirical survey, the respondent organisations' decision-practices and hurdle rate selection, the feasibility practices of respondents, the risk analysis practices and organisational cultural environment and the specific research questions this research aims to address which were outlined in section 5.9 of Chapter 5.

6.1 Empirical Data Response Rate

The data collection for the quantitative and qualitative empirical survey, as described in section 5.7, began in October 2015 and concluded in June 2016. Over this period, purposeful homogenous sampling was incorporated to increase the response rate. During the data collection period, 437 individuals were contacted/approached and invited to participate in the quantitative survey. Of those approached, 385 potential participants were contacted via telephone or email, with 187 completing the survey yielding a 48.6% response rate. This response rate is considered high in terms of survey participation. Baruch & Holtom (2008) found the average organisational response rate to be 35.7%, and Dillman (2001) found online survey formats typically are much lower.

Additionally, a representative of Estate Master invited 52 potential participants at training sessions to complete the survey, of whom 38 participants submitted completed written surveys yielding a 73.1% response rate. Overall of the 437 potential participants approached, 225 completed the quantitative survey which yielded an overall response rate of 51.5% which is above the minimum recommended response rate as suggested by Cook *et al.*, (2000) and Roth & BeVier (1998) to reduce non-response bias. It should also be noted that the organisation of the questionnaire through the use of an electronic survey platform allowed for a different pathway flow through the survey depending on the answers given in prior questions. For this reason, not all questions would have been answered by all respondents.

6.2 Characteristics of survey respondents (Independent Variables)

The following section summarises the results of the demographic and descriptive questions within the survey instrument. As discussed in Chapter 5, questions one to three of the survey were qualifying questions that sought to gain the respondent's consent for participation in the research and to determine respondent eligibility. For respondents to be eligible to participate in the research and complete the survey, it was important to qualify their role within the organisation where they are employed. The purposeful sampling aimed to select potential participants who are involved in the design, preparation or utilisation of feasibility analysis, site valuation or the decision-making processes in relation to their firm's or client's property development projects. Additionally, a qualifying question at the beginning of the survey required participants to indicate that they do meet the specified requirements, with regard to their role within the organisation they are employed. It should also be noted that in several questions within the survey, the comparison is made to surveys that covered similar subject areas including Costello and Preller (2010) and Wiegelmann (2012).

6.2.1 Respondent Profile

The organisation of the survey included questions designed to classify the structure and motivation types of the organisations in which the respondents are employed. These questions included developer profile, ownership structure and also included the type and size of development projects preferred. Further questions categorised the respondents as decision-makers based on their role within the organisation for which they are employed and also classified the internal decision-making processes adopted.

The term *real estate development* was previously defined in Chapter 2 as the 'product of a change of land use and/or a new or altered building in a process that combines land, labour, materials and finance' (Wilkinson & Reed, 2005, p. 3). Additionally, Drane (2013, p. 6) argued that property development was a 'value arbitrage in the transition of land from one use to another'. Arbitrage value occurs when there is value to be obtained by the change of use or the completion of a development project on the potential site through the use of regulatory land-use planning systems. When the value of the site is such that a change of use and completion of a property development project does not increase its value from the current use, then the arbitrage ends. Miles *et al.* (2008) described the entrepreneurial aspects of property development and described the process of development as taking an idea through to fruition when consumers - tenants or owner-occupants - acquire and use buildings put in place by the development team. These definitions of property development are limited in that they have regard to the development process but not to the ultimate purpose for development in the first place. The act of construction and the completion of buildings come together to create a structure or space that will benefit the ultimate end-user across the structure's lifecycle, but these definitions are limited in describing the various motivations behind a project being undertaken (Miles *et al.*, 2000).

Therefore, it was important to ascertain from respondents their primary motivation for assessing feasibility and hurdle rate selection by categorising their motivation by *Developer Type*. Section 2.5 in Chapter 2 demonstrated that property development organisations could be classified, and the types of developers described in that section were adopted in the survey instrument.

Respondents were asked to classify their developer type, and all 225 participants responded to this question.

6.2.2 Developer Types

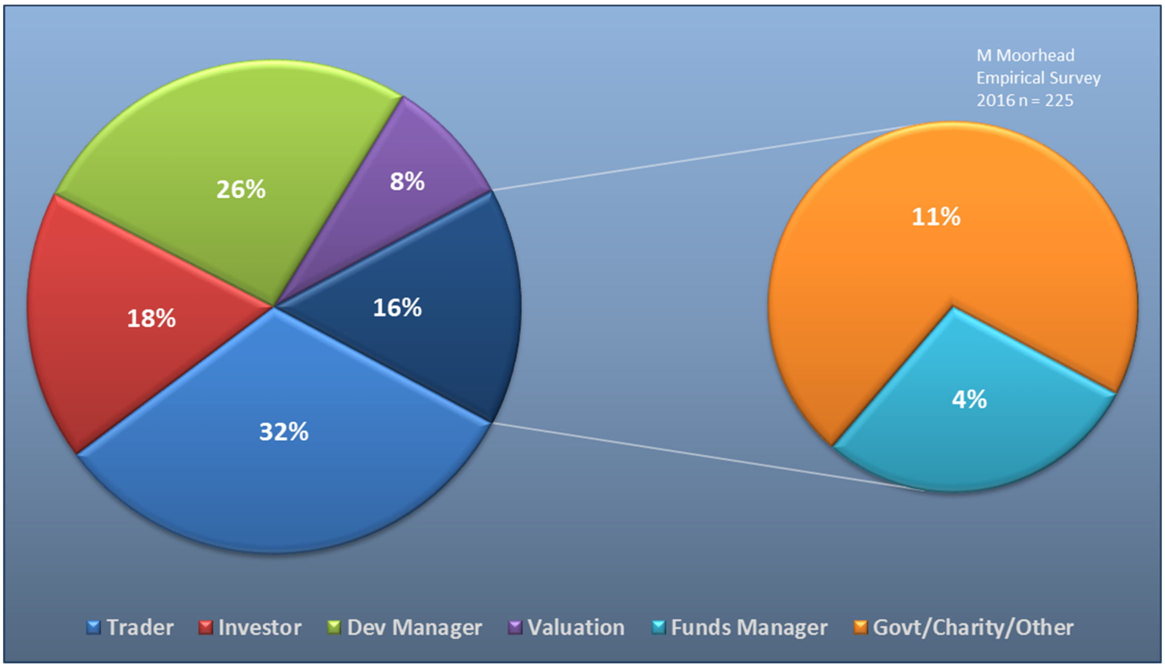
Developer Category: Which of the following best describes your company's business activities?

Participants were asked to provide details of the type of business activity in which the organisation where they are employed is engaged. The possible answers to this question included the following:

- Trader Developer - development of a product to on-sell
- Investor Developer - development to retain ownership
- Development Management - development on behalf of a client
- Valuation Firm
- Other, please specify.

Figure 6.2.2a demonstrates the distribution profile of the Developer Type of respondents. Within the survey, the two most frequent responses included 32% identifying their organisation as a 'Trader Developer' and 26% as *Development Management*. The combined 58% total comprising these two developer types demonstrates a predominate motivation for engaging in property development activity to derive economic profit, and the majority of development activity undertaken also being of a speculative nature. The 'Investor Developer' type at 18% of responses also includes the motivation of economic profit, but the difference being the intention to derive cash flows from collecting rent and with the secondary goal of obtaining capital gains over a longer time horizon.

Figure 6.2.2a: Developer profile types



Source: Author, 2018

As indicated in section 2.4.2, the two main methods of deriving economic profit from property development activities include obtaining a capital gain through speculation and receiving rental income through property investment. 'Valuation Firms' as respondents constituted 8% of survey responses and are included in this survey because these firms are involved in actively facilitating an important link in the procurement of capital for development firms to undertake projects and also form an integral part of the decision to commit to a project. Development finance lenders require independent valuation firms to prepare a feasibility analysis report on a proposed development project prior to a project's commencement and generally determines the loan gearing on a Loan to Cost Ratio (LCR) (Bryant, 2012). Therefore, it is important to gain an understanding of the views of valuation firms which have a major impact on whether development projects ultimately proceed. Additionally, valuation firms were included to gauge their required hurdle rates and risk perceptions in comparison to the property developers whose projects they are analysing. It should also be noted that financial institutions who provide capital for property development firms give instructions to valuation firms which may influence the hurdle rate used as a basis for feasibility analysis (RICS *Valuation of development Land*, 2008).

It is important to understand the motivation of the respondent in relation to their developer type. It was found that 11% of respondents indicated they work for a government-owned entity, charity or other organisation. There exist wholly and partially government-owned development companies. These companies may require economic profit as an over-arching objective but, often, have other objectives as the primary motivations for engaging in real estate development projects (Wilkinson *et al*., 2015). As discussed in section 2.4.1 EDQ is an example of a Queensland government-owned organisation which regularly conducts real estate development projects. EDQ specifies which their organisational purpose is:

> *Engaging with state and local government, the development industry and the public to identify, plan, facilitate and deliver property development and infrastructure projects to create prosperous, liveable and connected communities.* (Department of Infrastructure, 2016)

Additionally, EDQ views creating land supply and key infrastructure projects as important in generating employment opportunities in key areas.

Further analysis concerning the differences between developer types regarding the selection and use of specific hurdle rate metrics are given in the determination of research question **RQ2c** in section 6.3.5 and are also summarised in the presentation of the key findings in section 6.7.

6.2.3 Respondent geographic distribution

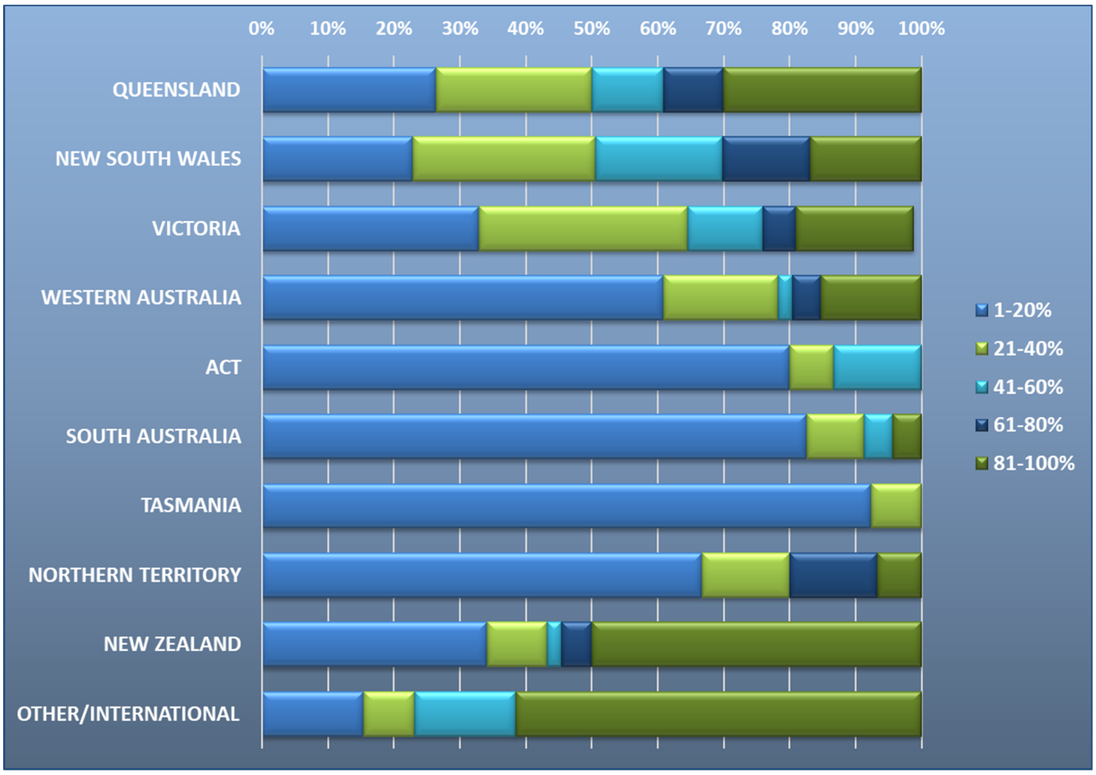
In which countries do you conduct property development projects?

Table 6.2.3 identifies the respondent organisations' global geographic distribution of projects. A total of 203 different participants indicated the geographic areas in which their organisation conducts property development projects. Some respondents represent valuation firms or other organisations that do not directly undertake projects, therefore not indicating a geographic region. The rate of internationalisation of property development organisations has been increasing over the past decade and respondents were able to choose more than one geographic area in which they conduct property development projects (Squires & Hutchinson, 2016). A total of 6% of respondents indicated they operate in multiple countries and, as multiple responses were possible, there was a total number of responses of 218. As this research is primarily concerned with the practices of property development organisations in Australia, these areas were specifically targetted in the selective purposeful sampling process described in Chapter 4. In total, 171 of respondents indicated that they conduct development projects in Australia, and 20 respondents indicated New Zealand as a geographic area making up the second-largest country in terms of representation. A combined 84% (n = 191) of respondents indicated they operate in the Antipodean region.

Respondents were also asked to break down the geographic percentage by the dollar value of their organisation's development projects along the basis of New

Zealand, Australian states and territories and/or other nations. Figure 6.2.3 demonstrates that many property development organisations operate across several regions with a relatively small percentage (< 20%) of their projects by dollar value being conducted in different areas.

Figure 6.2.3: Geographic distribution percentages of property development projects (AUD end value) by state and region



Source: Author, 2018

It is interesting to note that the dispersion distribution for smaller (by transaction volume) markets attract more of a local focus, and the larger more economically complex markets demonstrate a more diverse distribution of activity. Further analysis concerning the differences between developers in different geographic areas and the selection and use of specific hurdle rate metrics are given in the determination of research question **RQ 2g** in section 6.3.5.

Table 6.2.3: Geographic distribution of projects

Country	Responses	% Response
Australia	171	76%
New Zealand	20	9%
Other (North/South America, Oceania)	27	12%
Did not indicate/No primary Country	7	3%
Total	225	100%
Australia & New Zealand	191	88%
Other Countries	27	13%
Total (of responses)	218	100%

Source: Author, 2018

6.2.4 Respondent ownership structure

Please provide details of the ownership structure of your organisation.

Participants were asked to provide details of the ownership structure of the organisations where they are employed. The possible answers to this question included the following:

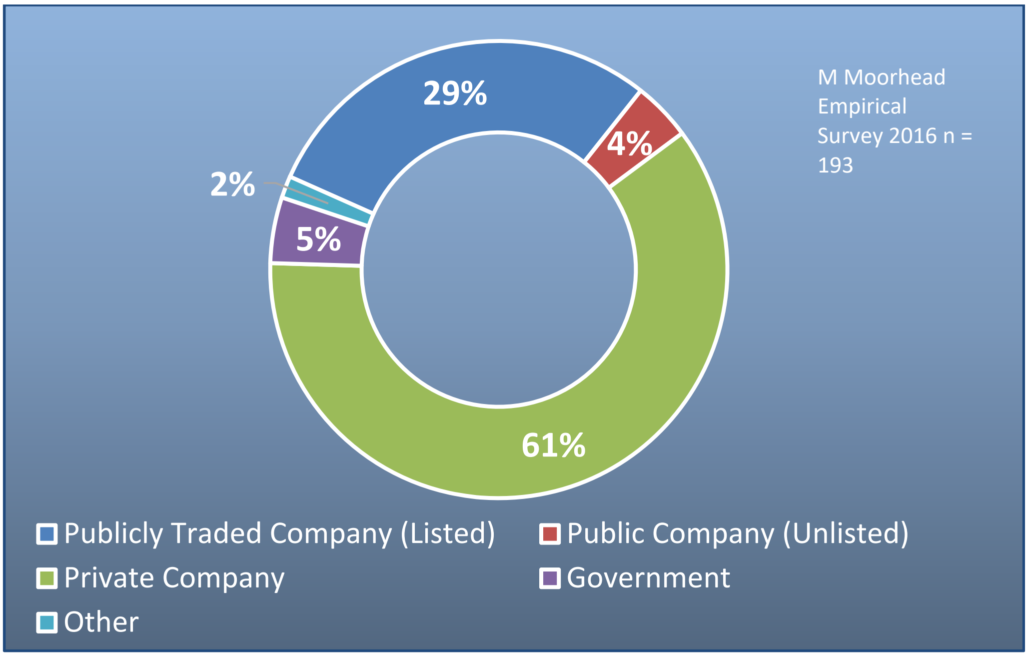
- Publicly Traded Company on the ASX (or international exchange)
- Public Company (Unlisted)
- Private Company
- Or Other (please specify).

The responses that indicated 'Other' were predominately government organisations and were assigned a unique category in the data coding. In total

193 respondents answered this question, and the results are demonstrated in Figure 6.2.4.

The predominate corporate/ownership structures included private companies (61%, *n* = 117) and public companies listed on the ASX or an international exchange (29%, *n* = 56). Government organisations totalled 5 per cent of responses, unlisted public structures equalled 4 per cent of responses and 'Other' equalled 2 per cent of responses forming the remaining constituents of the ownership structure matrix. There exists a paucity of information available on the ownership structure of property development organisations in Australia, but the few studies that have addressed this issue indicate the generally accepted view that the predominant structure for property development organisations, not listed on a stock exchange, is a private company structure with an associated trust structure due to the high levels of risk and return volatility attributed to property development projects (Dowling, 2005; Fincher, 2007; Ball, 2003).

Figure 6.2.4: Ownership structure of participant organisations



Source: Author, 2018

This result is similar to the results other studies reported and reflected the generally accepted belief regarding property development organisational structure. For example, Preller (2009) found 45 per cent of respondents (Queensland property developers) were publicly listed and Wiegelmann (2012) found 33 per cent of European property developers surveyed were publicly listed. Further analysis concerning the differences between developers with differing ownership structures regarding the selection and use of specific hurdle rate metrics are given in the determination of research question **RQ 2b** in section 6.3.5.

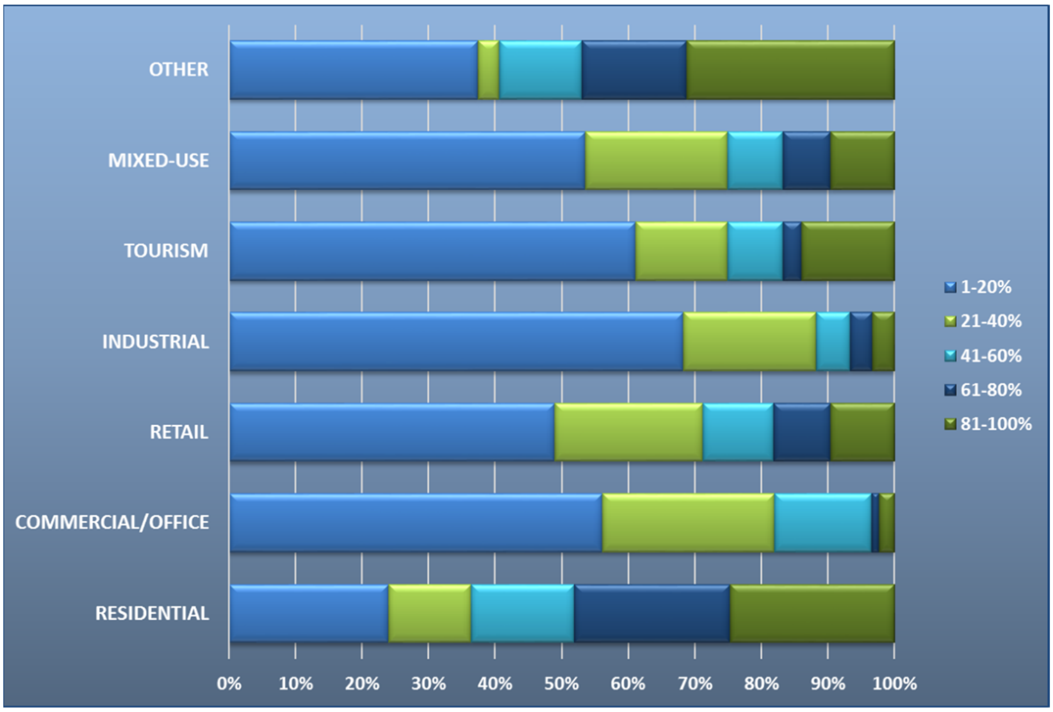
6.2.5 Type of development projects

Please provide the property type distribution percentage based on the monetary value of your organisation's property development projects.

Figure 6.2.5a gives an overview of the percentage of each type of property representation which respondents indicated their organisation undertake within the overall level of development projects. Table 6.2.5 illustrates the dominant type of property that a respondent's company undertakes for their property development projects. A property development type category was defined as dominant if that company completes at least 40% of their projects in a single property type. Many companies did not have a dominant property type (21% of respondents) and were then classified as a mixed-use developer. The largest classification of property type was residential developers, constituting 39% of respondents. This result was as expected given that the majority of buildings constructed in Australia (65.5% in the year to June 2018) and New Zealand (65.1%

in the year to September 2018) where residential in character (ABS, 2018b; Statistics New Zealand, 2018).

Figure 6.2.5a: Distribution percentage (AUD end value) of the type of property developed



Source: Author, 2018

Table 6.2.5: Type of development projects

	Responses	Response %
Residential Majority	98	39%
Commercial Majority	16	6%
Retail Majority	27	11%
Industrial Majority	27	11%
Tourism Majority	9	4%
Mixed-Use or No Dominant	53	21%
Other, Childcare, Retirement, Infrastructure	19	8%
Total	249	100%

Source: Author, 2018

Retail and Industrial as a dominant development type each made up 11% of responses with the Childcare/Other forming 8% of responses and the surprise being that only 6% of respondents indicated the commercial type of property as dominant, but these organisations tended to undertake larger sized projects. It should be noted that 30% of respondents listed commercial property as a non-dominant property type of development project completed. The majority of these non-dominant commercial property developers listed residential development as their majority property type.

Further analysis concerning the differences between the development of different property types and the selection and use of specific hurdle rate metrics are given in the determination of research question **RQ2a** in section 6.3.5.

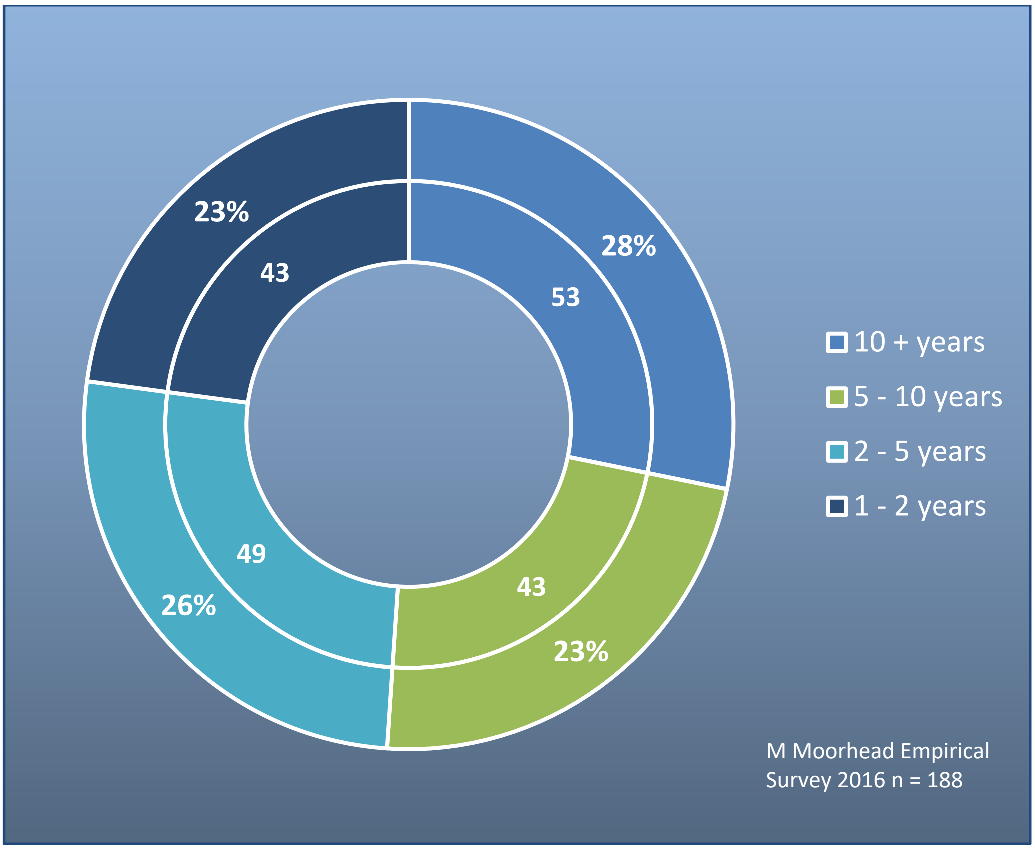
6.2.6 Experience versus novice respondents

Please indicate your level of experience in the decision-making process where you are involved in determining to proceed or not proceed with potential property development projects.

Respondents were asked to indicate the number of years of experience they had in the decision-making process of whether to proceed with potential projects and the results are summarised in Figure 6.2.6 and Table 6.2.6. A total of 188 (84%) of participants responded to this question in the survey.

The sample characteristics indicate an even spread across the experience brackets with 28 per cent of the respondents having more than ten years' experience, 23 per cent having five to ten years' experience, 26 per cent having two to five years' experience and 23 per cent with relatively little experience fewer than two years. The years of experience does not indicate workforce or industry experience but is concerned with the experience in the decision-making process of deciding whether to proceed with potential projects. Many project managers in the property development industry will have many years of industry experience before being placed in a position to decide on which projects the organisation will pursue.

Figure 6.2.6: Respondent years of experience



Source: Author, 2018

Just over half of respondents (51%) had five or more years' experience with 28% having significant experience of ten or more years. Within the structural framework of property development companies, it is common for development managers to assess the feasibility of a development project early in their career. The qualitative structures in place will allow a site that passes a particular level of analysis to be progressively passed up the hierarchy where increasing levels of scrutiny will be applied. Having a large number of respondents with high levels of experience is potentially advantageous to help differentiate how hurdle rates are selected and modified in light of various degrees of uncertainty in a proposed project. Sah *et al.* (2010) found that some differences do exist in the decision making of experienced decision-makers versus novices when analysing real estate investment decisions (Sah *et al.*, 2010). Their research found that more experienced decision-makers made use of a broader range of information to form a basis for their decisions where novices tended to fall back on more specific quantitative measures dictated by the organisation's policy. Their findings indicate why it is common to have a fairly rigid set of quantitative hurdle rates used in analysing project selection.

Table 6.2.6: Respondent years of experience

	Responses	% Responses
10 + years	53	28%
5 - 10 years	43	23%
2 - 5 years	49	26%
1 - 2 years	43	23%
Total	188	100%

Source: Author, 2018

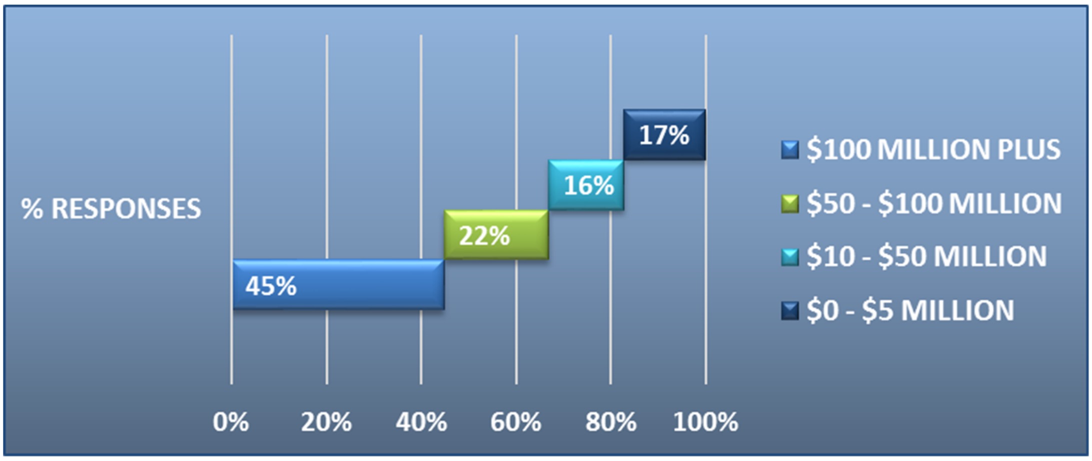
Further analysis concerning the differences between respondents of differing experience in years and the selection and use of specific hurdle rate metrics are given in the determination of research question **RQ2d** in section 6.3.5.

6.2.7 Project size of respondents

Please indicate the approximate project size your company prefers to undertake.

The survey respondents' responses to this question revealed a broad range of preferred project sizes and the results are summarised in Table 6.2.7 and Figure 6.2.7a.

Figure 6.2.7a: Dominant preferred project size ($'s)



Source: Author, 2018

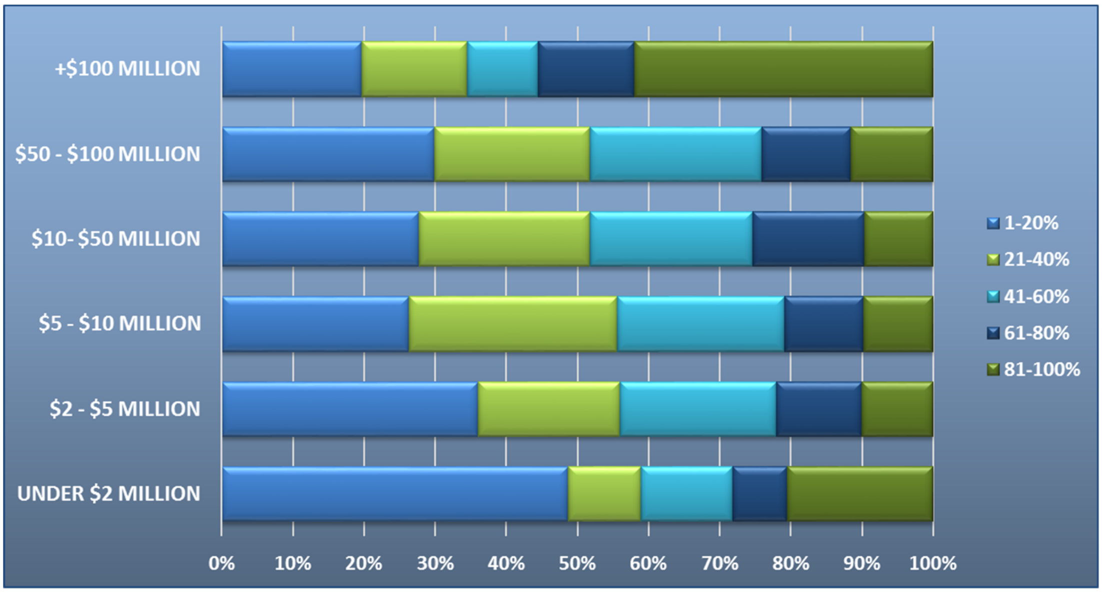
Table 6.2.7: Respondent preferred project size

	Responses	% Responses
$100 million plus	65	45%
$50 - $100 million	32	22%
$10 - $50 million	23	16%
$0 - $5 million	25	17%
Total	145	100%

Source: Author, 2018

The project sizes were chosen to classify respondents as either small, small-medium, medium-large or large developers regarding the size of projects that they prefer to undertake. Figure 6.2.7b breaks down project size by the percentage of the projects undertaken by the property development organisation in terms of AUD end value. The chosen sizes are also an indication of the type of funding required and the difficulty faced by developers in funding projects of a larger size. In total, 145 survey participants responded to this question, and just under half of the respondents (45%) can be placed in the large developer category with preferred projects over $100 million.

Figure 6.2.7b: Percentages of preferred project size by project cost (AUD end value)



Source: Author, 2018

Prior surveys of property developers in Australia have tended to focus on the larger developers (see Newell & Steglick, 2006 and Preller, 2009), but the break-up of respondents into the small and medium sizes allows for analysis of the differences in hurdle rates of development companies based on size. Very little is to be found in current literature on the decision processes of small property developers.

The distribution frequency of Figure 6.2.7b demonstrates that larger property development projects are generally taken on by larger property development organisations and smaller property development projects are more likely to undertake smaller development projects.

6.2.8 Educational background of respondents

Please indicate the highest level of education you have completed.

Respondents were asked to indicate the highest level of education completed and also whether they have a formal qualification in a property-related course. Table 6.2.8 and Figure 6.2.8a summarise the results:

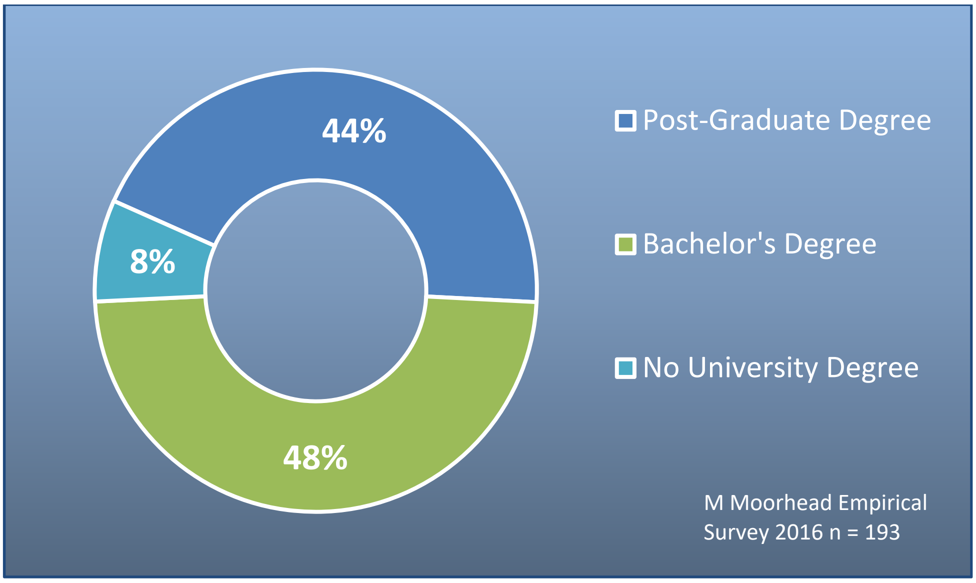
Table 6.2.8: Educational background of respondents

	Responses	% Responses
Doctorate or Professional Degree	4	2%
Master's Degree	61	32%
Post Graduate Diploma	18	10%
University Bachelor's Degree	91	48%
Diploma or Trade Certificate	8	4%
High School or Equivalent	6	3%
Total	188	100%

Source: Author, 2018

The response rate to this question was *n*=188 (84%) with the overwhelming majority of respondents indicating having a university degree (92.5%). This result indicates an overall high-level of qualification for decision-makers at the project level. Additionally, 44 per cent of respondents also had a post-graduate degree with only 7 per cent indicating a trade certificate or high-school equivalent as their highest level of education.

Figure 6.2.8a: Highest level of education

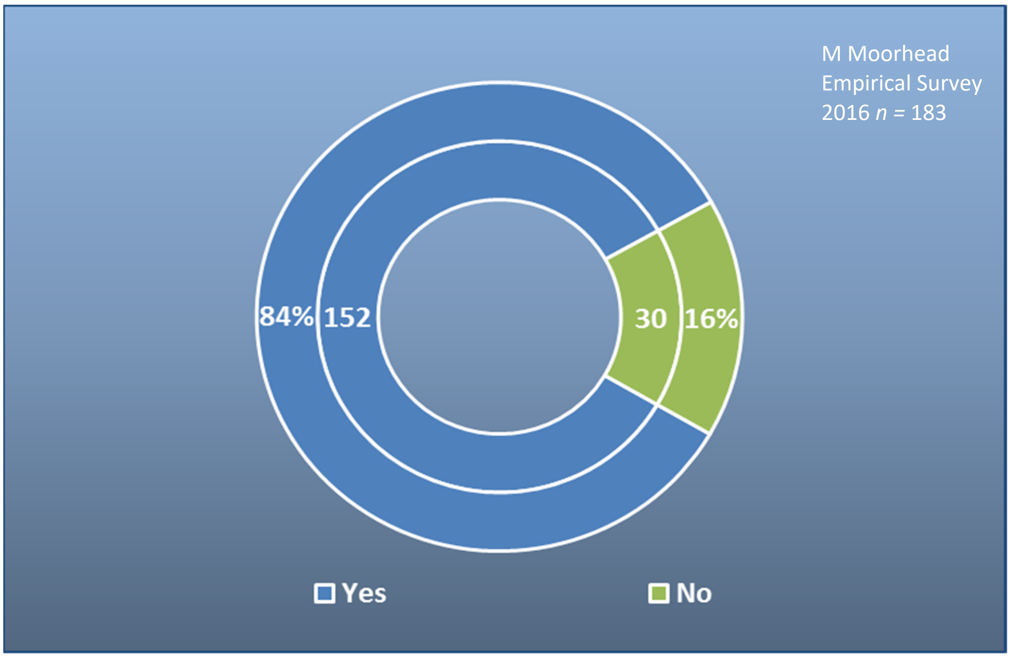


Source: Author, 2018

Were any of your qualifications in a property-specific related course?

Respondents that indicated that they had obtained a university degree were also asked if they had a property-related degree qualification, with 84 per cent of the 183 responses to this question indicating having a property-related qualification when referring to their level of education. Many of the 16 per cent of respondents who indicated not having a property related qualification, indicated either engineering, project management or law qualifications as their primary area of education. Figure 6.2.8b summarises the responses to this question. Further analysis concerning the differences between the educational level of survey respondents or if they have a property related degree and the selection and use of specific hurdle rate metrics are given in the determination of research question **RQ 2e** in section 6.3.5.

Figure 6.2.8b: Respondents who have a property-related degree



Source: Author, 2018

6.2.9 Contribution of responses regarding the characteristics and demographics of property developers

Section 6.2 provided a narrative of the characteristics and demographic attributes of respondents. These attributes allow for the creation of descriptive filters in areas of the developer motive and type of property developer, the type of property respondent organisation's development projects, ownership structure, the geographic distribution of projects, respondent experience, education levels and preferred project size. These filters can now be used to provide insight into the decision processes, hurdle rate selection, feasibility practices, risk analysis practices as well as the management culture of respondent property development organisations.

6.3 Decision processes & hurdle rate selection (dependent variables)

This section is seeking to understand the organisational decision-making processes of survey respondents in deciding whether to proceed with a property development project in the pre-commitment stages of the development process. A primary aim of this research is to explore the various decision methods used, identify their level of use and the importance of each method to different sectors of the industry. An analysis was conducted on respondent organisations decision-making structures including the approval process within the organisation, the use and selection of project hurdle rates and specific mechanisms for the adjustment of project hurdle rates. The following sections provide a narrative into how respondent property development decision-makers choose, utilise and adjust specific project hurdle rates as well as the composition and function of their organisational structure in regards to conducting viability studies and choosing to proceed with projects beyond the pre-commitment stages of the development process.

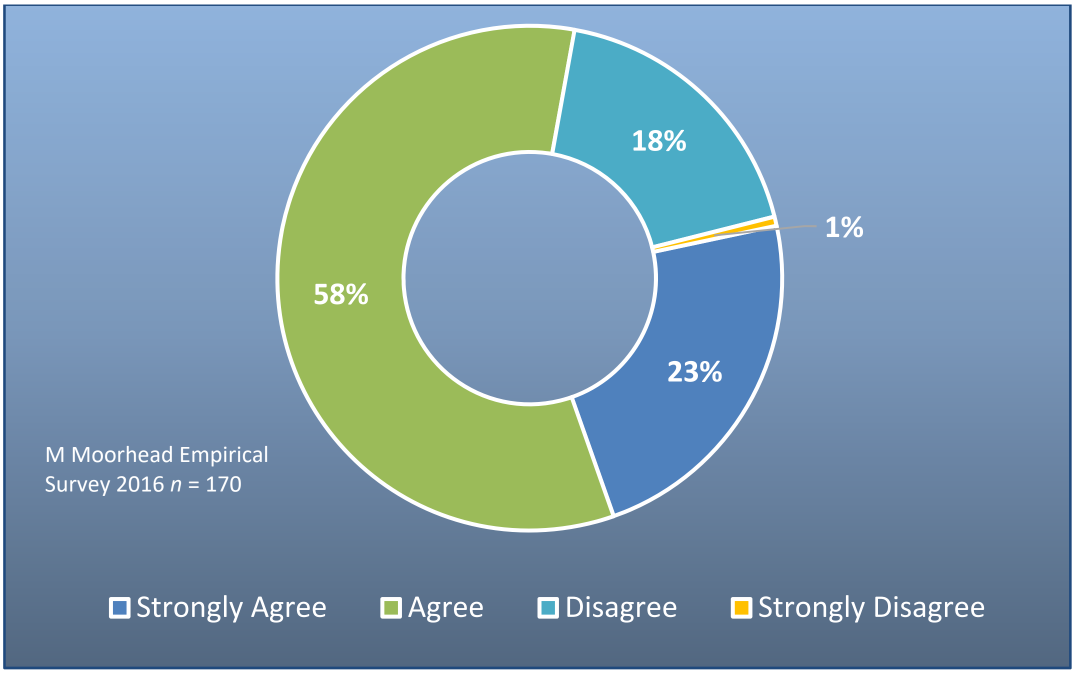
6.3.1 Specialised decision-making structure

In the pre-commitment stage of the project development process, the company applies a consistent decision-making methodology.

Respondents were asked to indicate if they strongly agree, agree, disagree or strongly disagree with the statement that the company they work for applies a consistent decision-making methodology. The results of this question, shown in Figure 6.3.1a, indicate that the majority of respondents either strongly agree (23%) or agree (58%) with the statement that there is a consistent methodology applied throughout the company, versus respondents that either disagree (18%)

or strongly disagree (1%). The responses demonstrate a high level of confidence that the organisation for which they are employed is consistent in its decision-making methodology. This question was also coded into an additional variable where those that either strongly agree or agree (81%) were combined and those that either disagree or strongly disagree (19%) were combined to allow for further analysis.

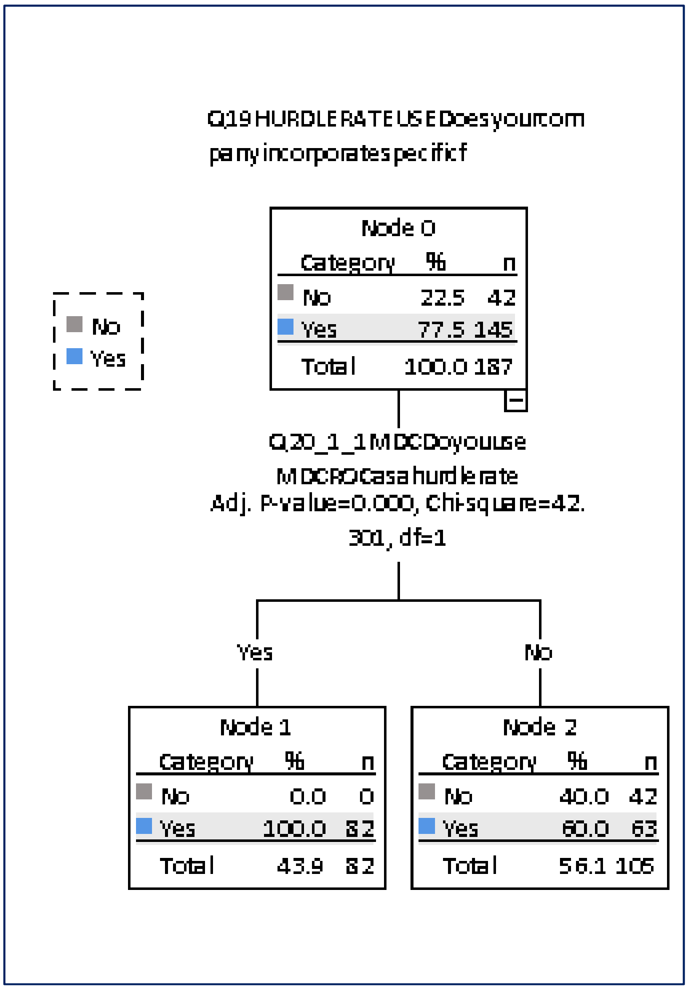
Figure 6.3.1a: The company applies a consistent decision-making methodology



Source: Author, 2018

A decision tree analysis was conducted as a preliminary investigation to find strong predicters regarding the decision-making methodology of survey respondents. This analysis revealed a strong association with the use of the MDC hurdle rate with a consistent decision-making methodology and the CHAID model was also able to predict 77.5% of cases as demonstrated in Figure 6.3.1b, see Appendix D-2.

Figure 6.3.1b: Decision Tree analysis of the use of specific hurdle rates and a consistent decision-making methodology



Classification

Observed	Predicted		
	No	Yes	Percent Correct
No	0	42	0.0%
Yes	0	145	100.0%
Overall Percentage	0.0%	100.0%	77.5%

Growing Method: CHAID

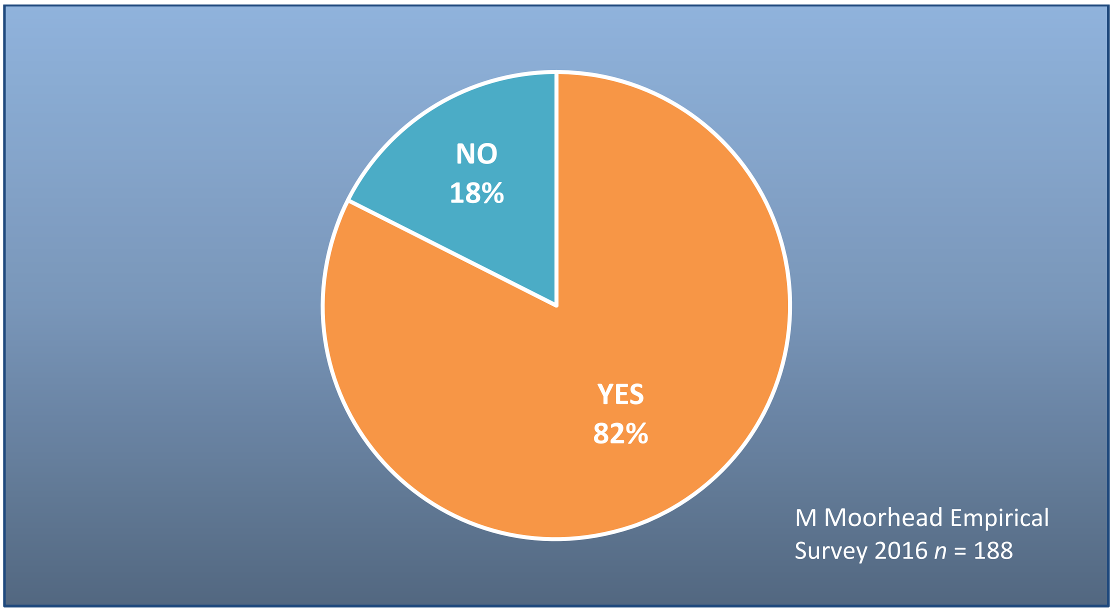
Dependent Variable: Q19 Company uses specific hurdle rates

Source: Author, 2018

Is there a specialised board, senior management or committee that must approve the decision to proceed beyond the pre-commitment stages of the development process?

If yes, what is the type of specialised board, senior management or committee that must approve the decision to proceed beyond the pre-commitment stages of the development process?

Figure 6.3.1c: Formalised decision process



Source: Author, 2018

Figure 6.3.1c demonstrates that 83% of the 188 respondents who answered this question indicated that the organisation they work for had a formalised structure for deciding to proceed with a project beyond the pre-commitment stages of the development process. This decision structure would generally be utilised at the completion of a due diligence period, hence before site acquisition.

Figure 6.3.1d demonstrates that 63% (n = 188) of responses indicate a single level or point of project decision approval. Respondents with multiple levels of required approval were equal to 19% of responses, and 18% of respondents did not indicate a level of required approval to proceed beyond the pre-commitment stages of the development process. Table 6.3.1 breaks down the responses on the required specific types of approval.

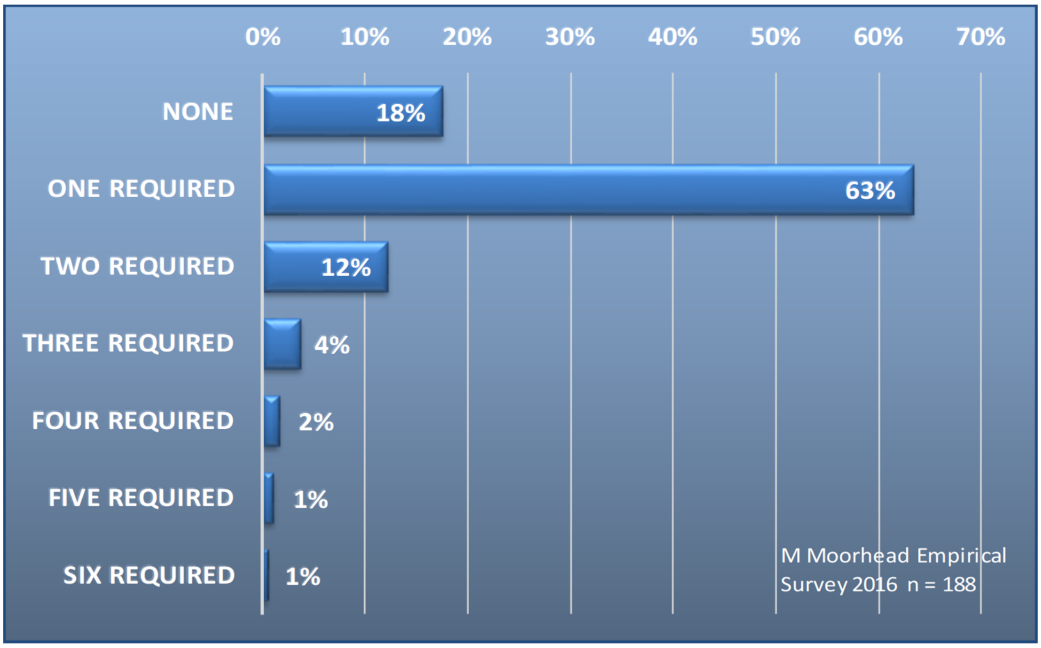
Table 6.3.1: Required approval for the decision to proceed

	Responses	% Responses
Company Board	106	56%
General Manager	47	25%
Financial Controller	17	9%
Senior Development Manager	18	10%
Risk Officer or Risk Committee	11	6%
Investor's Approval	15	8%
Total	214	

*more than one response is possible

Source: Author, 2018

Figure 6.3.1d: Number of levels of approval required for project commencement



Source: Author, 2018

Respondents were also given the opportunity to describe their approval process and indicate other methods of obtaining approval to proceed with the following question:

> ***If you selected 'other' in the question above. Please describe the process that occurs in order to approve the decision to proceed or not proceed with potential property development projects.***

The results indicate the majority (56%) of respondent organisations require a company board to approve site acquisitions. followed by 25% of respondent organisations requiring the sign-off by a specific General Manager. This process of seeking board or the General Manager' approval, as indicated by the open-ended responses, typically involves the preparation of a feasibility analysis and other supporting information to put forward a business case in support of the purchase of the site and for undertaking the project. The board may consist of senior development managers, risk officers, executive management/directors or non-executive directors who review the material submitted by acquisition staff and make a decision on what is best for the organisation at a strategic level.

There was a total of thirteen responses to the open-ended questions which indicated the organisation for which they are employed has an approval system different to the choices available. The responses can generally still be classified as having an approval process similar to the available choices, but they differed due to corporate structural issues or having to seek approval through a structure of grouped investors. These open-ended answers give insights into how the process of board approval and/or investor approval operates. Specific examples of comments provided include the following:

Example 1: High-level overview of the business case and financial model for the development including indicative plans etc, which are used to confirm whether there is the support to proceed (or amend as required).
(Senior Development Manager / Medium-Large Project Size/ Primary Retail Type/ Publicly Listed Company/ 10+ years experience)

Example 2: Initial site feasibility is generally prepared by the Acquisition team in consultation with the Development Manager to ensure costs estimates are accurate. This feasibility is then presented to the two owners of the business, who will decide about whether they wish to proceed with the purchase of the site.
(Development Manager / Medium-Small Project Size/ Primary Residential Type/ Private Company/ 2-5 years experience)

Example 3: We have a unique structure where we have an acquisition/development company that sits separately to a property trust. 80% of sites that we find will inevitably be 'developed' and owned by the property trust and the acquisition company has a separate childcare operations company that operate all sites that we find and develop. The other 20% of sites may be leases or are developed by other companies under our supervision, so we get the exact product at the end that we want, with the long-term intention that we have a long-term lease on the property. All site acquisitions come down to the acquisition company and where they sit in terms of ongoing building ownership is what varies.
(Development Manager / Small Project Size/ Other Development Type/ Private Company/ 2-5 years experience)

Example 4: Generally, a decision is made by the investors. Typically, there are 3 to 4 investors that put money up for the development and ultimately make a decision on everything.

(Senior Development Manager / Medium-Small Project Size/ Primary Residential Type/ Private Company/ 5-10 years experience)

These examples indicate that the structure of many development projects appear complex and the boundaries between traditional speculative development and property investment through the use of securitisation methods are becoming more difficult to distinguish. Additionally, the results highlight that the majority of development organisations in this survey do not rely purely on quantitative metrics of project viability to make a decision, but use qualitative methods and organisation structural checks and balances as a method for managing the organisations' risk.

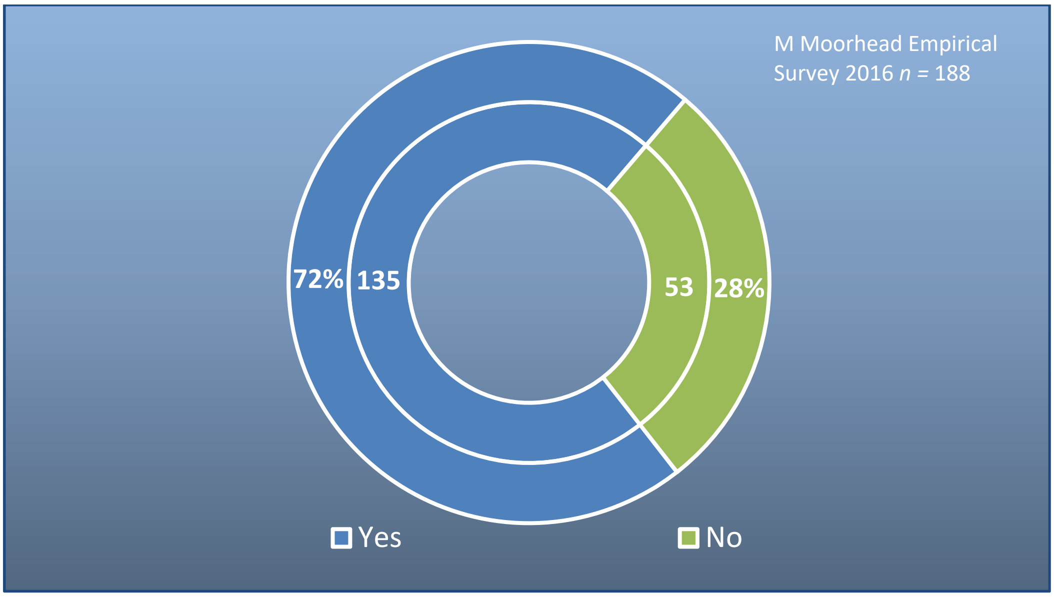
Even though the majority of responses indicate that development organisations rely on a single level of approval, the nature of that approval is at the corporate board or executive level rather than at the level of project management. Smaller development companies that do not have boards or a formal risk management process are more likely to require the approval of the General Manager.

6.3.2 Use of specific quantifiable go/no-go decision processes

Does your company use a specific quantifiable go/no-go decision process in order to decide whether to proceed with a development project? This may be pre-set requirements such as forecasted profitability meeting a return on cost (ROC) of X% for example.

Respondents were asked if they utilise a specific go/no-go decision process in deciding to proceed with a project beyond the pre-commitment stages of the development process. The results are summarised in Figure 6.3.2 with the majority of respondents, 72%, indicated that the organisation in which they are employed does utilise a specific go/no-go decision process in decision-making, and 28% of respondents indicated that the company they work for does not. This result is in line with the results of other surveys such as Hutchison *et al.* (2017) which found 80% of property investors and developers surveyed in the UK used a specific hurdle rate as a decision metric applied to each project or investment. Additionally, the result is also similar to that found by Preller (2009) and Crosby *et al.* (2018a; 2018b) indicating that property development organisations typically incorporate specific go/no-go decision processes.

Figure 6.3.2: Summary of responses to go/no-go decision process



Source: Author, 2018

6.3.3 Hurdle Rate Selection

Does your company incorporate specific fixed financially based hurdle rates as a basis for project decisions? (Example: IRR, NPV, MDC or ROC)

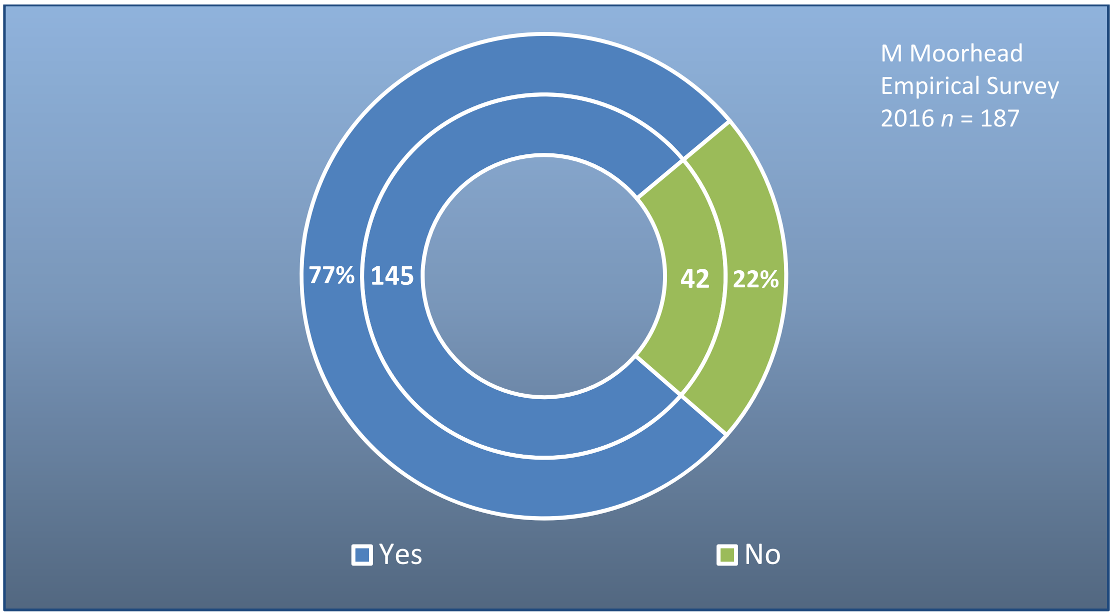
Please nominate the specific fixed financially based hurdle rates used and a rough guideline of the required financial metric for project decisions your company uses? (Example: IRR, NPV, MDC or ROC)

Respondents were asked if they incorporate specific financially based hurdle rates to decide whether to proceed with a development project. A large majority (77%) of responses indicated that they do use specific financial hurdle rates and 22% indicated that they do not as shown in Figure 6.3.3a. The 77% of respondents who indicated the use of specific fixed financial-based hurdle rates were then asked to specify which hurdle rates they use and give an indication of the minimum financial metric value they typically adopt. Respondents were also given the opportunity to specify additional hurdle rates and discuss their use in an open-ended question. Figure 6.3.3b and Table 6.3.3 demonstrate the level of use of common hurdle rates in the sample of the property development industry, and it should be noted that more than one response was possible. The results are broadly in line with what was expected and in comparison to the relevant literature on hurdle rates usage in property development (Costello and Preller, 2010; Wiegelmann, 2012; IPD (2010), Crosby *et al.*, 2018a; Hutchison *et al.*, 2017).

The most commonly used hurdle rate, at 40% usage, was MDC which can also be referred to as return on cost (ROC). The values specified by respondents ranged from 10% to 30% with respondents able to indicate a lower and higher percentage range for their projects. The results also indicated a median MDC percentage at 20% and the mean at 19.3%. The median value demonstrates, as discussed in Chapter 3, the ubiquitous belief in the Australian and New Zealand property development industries that a project should achieve a minimum MDC of 20% in order to justify the risk of undertaking that project. Additionally, the majority (65%) of respondents who use MDC as a hurdle rate indicated that they use exactly 20% as the minimum MDC percentage acceptable for a project. This result is similar to that found by Diaz III (2010); Sah *et al*. (2010); Rowley *et al*. (2014) and Crosby *et al*. (2018a) where industry-based heuristic rules of thumb are applied to decision making on property investment and property development decisions.

This very high adoption of a specific figure shows the predominant use of a normative approach and a large level of acceptance of the industry rule of thumb. It should also be noted that the standard deviation of the indicated MDC hurdle rates was found to be 1.41% demonstrating an extremely tight grouping of the acceptable MDC percentage for a project. The second most commonly used hurdle rate was IRR at 32% usage, and this result was interesting given recent literature that questions the usefulness of IRR on speculative property development projects (Crosby *et al*. 2018a).

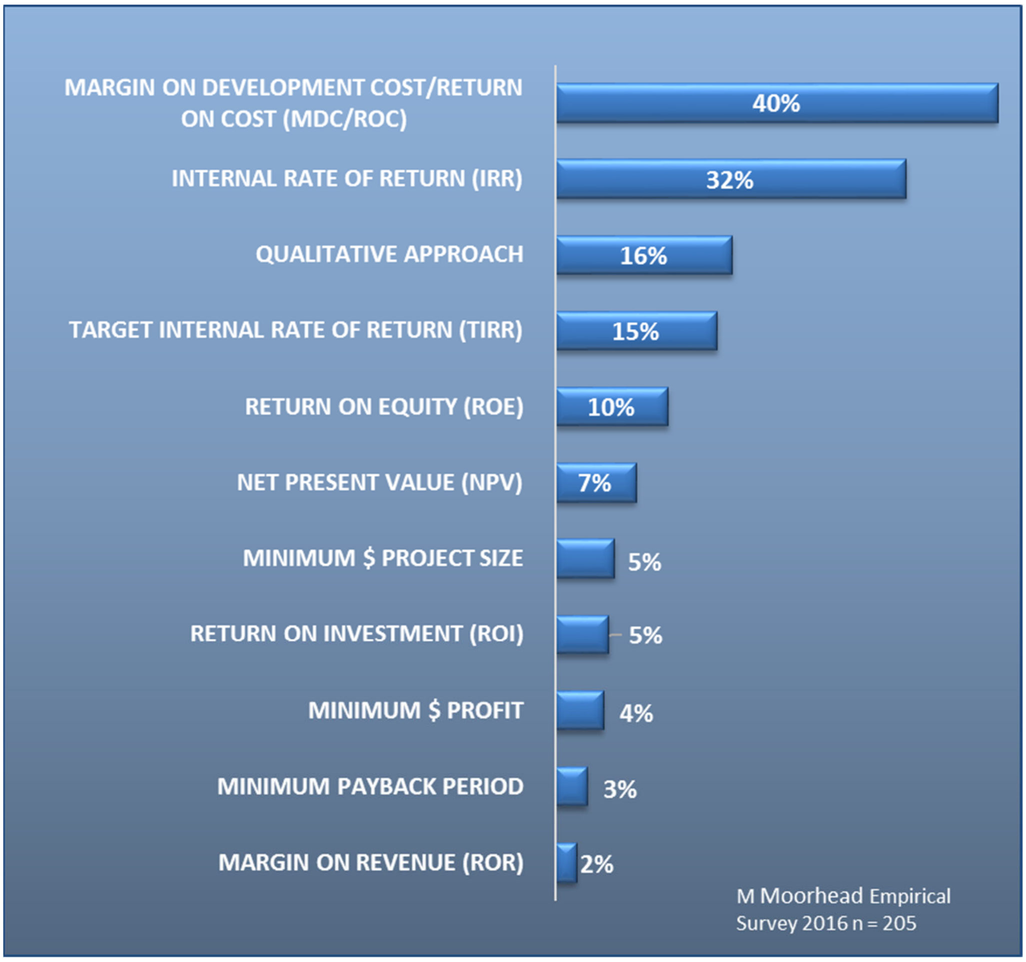
Figure 6.3.3a: Responses to use of specific fixed financial-based hurdle rates



Source: Author, 2018

The mean minimum acceptable IRR percentage for a project was 18.17%, and the median was 18%. The minimum IRR percentage indicated was 10% and the maximum was 30%, and the standard deviation was a very narrow 4.85%. This result was similar to the MDC/ROC result in that industry decision-makers demonstrate a very narrow range of acceptable IRR percentages and adoption of the industry 'rule of thumb' in relation to the use of IRR.

Figure 6.3.3b: Percentage frequency of specific hurdle rates used in project decision making of all survey respondents



Source: Author, 2018

A surprising result was the relatively low-level usage of NPV as a project decision hurdle rate at 7%, given the ability within many proprietary feasibility analysis programs to calculate this financial metric using the DCF method of feasibility analysis. Respondents indicated 16% usage of hurdle rates that are not specific financial metrics and will be defined in this research as a *Qualitative Approach* hurdle rate.

Table 6.3.3: Specific hurdle rates parentage use and descriptive result

Hurdle Rates	% Use	Mean	Median	Minimum	Maximum	Standard Deviation
Margin on Development Cost/Return on Cost (MDC/ROC)	40%	19.30%	20.00%	10.00%	30.00%	1.41
Internal Rate of Return (IRR)	32%	18.17%	18.00%	10.00%	30.00%	4.85
Qualitative Approach	16%					
Target Internal Rate of Return (TIRR)	15%	19.93%	20.00%	15.00%	30.00%	4.03
Return on Equity (ROE)	10%	36.67%	25.00%	10.00%	100.00%	25.56
Net Present Value (NPV)	7%					
Minimum $ Project Size	5%	$ 46,777,778	$ 20,000,000	$ 2,000,000	$300,000,000	78,103,742
Return on Investment (ROI)	5%	26.67%	20.00%	10.00%	80.00%	21.65
Minimum $ Profit	4%	$ 3,162,500	$ 1,000,000	$ 300,000	$ 10,000,000	4,235,542
Minimum Payback Period	3%	8.33	5.00	5.00	20.00	6.05
Margin on Revenue (MOR) / Return on Revenue (ROR)	2%	25.00%	25.00%	25.00%	25.00%	0.00

Source: Author, 2018

Respondents indicated the usage of a target internal rate of return (TIRR) at 15%. A TIRR is often used when there is a requirement for the use of residual land value calculations at the site acquisition stage of a project. The project analyst will calculate the required profit on a project and solve the development equation to determine the residual land value using one or more of the methods described in Chapter 3. If an IRR is used as the project hurdle rate, then the desired project IRR is set as a target internal rate of return (TIRR) which must be given to calculate the maximum bid price for the land. However, it should be noted that when a project manager is forecasting an IRR in a feasibility analysis for a potential project the IRR and TIRR are essentially the same. Both MDC and TIRR are common methods used in residual land value calculations. Similar to the IRR and MDC results, the standard deviation was 4.03% with the mean minimum TIRR of 19.93% and the median at 20.00% with the range of minimally acceptable TIRR at 15% and the maximum at 30%.

Other hurdle rates utilised by respondent development organisations included ROE at 10% usage, minimum dollar project size and ROI at 5% usage, minimum dollar profit on the project at 4%, minimum payback period at 3% usage and margin on revenue or MOR at 2% usage. Table 6.3.3 gives the respondent responses regarding hurdle rate usage including the mean, median, minimum, maximum and standard deviation of results.

If you selected 'other' in the question above. Please list and describe additional hurdle rates used in order to approve the decision to proceed or not proceed with potential property development projects.

There was a total of eight responses to the open-ended questions asking respondents to list additional hurdle rates used to make a decision to proceed or not proceed with a project. The responses which allowed respondents to list and describe hurdle rates different to those described in Figure 6.3.3b were predominately focused on the needs of clients of Developer Managers who are undertaking investment development projects, or for not-for-profit organisations where economic profit is not the primary project objective. Specific examples of comments provided include the following:

> *Example 1: For commercial assets, the key returns are average fund distributions as well as average total distributions (income and any capital value, e.g. cap rate compression on exit). Different funds may focus on IRR,*

> *Annual distributions or total annual distributions depending on their investment mandate. For example, a client looking for core income producing properties with a long-term hold will likely focus on average annual distribution.*
> *(Development Manager / Large Development Project Size/ Primary Commercial Type/ Publicly Listed Company/ 5 – 10 years experience)*
>
> *Example 2: Peak Equity / Debt plus a project's required to deliver a target margin with minimal to zero price escalation. Peak equity and peak debt are large considerations to equity investors.*
> *(Senior Development Manager / Large Development Project Size/ Primary Residential Type/ Private Company/ 5 – 10 years experience)*
>
> *Example 3: Not-for-profit organisations receive donations/grants etc. which determines the allocation of investment. If any metrics are used it's an 'on going' analysis of operational costs that gets calculated.*
> *(Development Manager / Medium-Small Development Project Size/ Primary Other Development Type (non-profit)/ Private Company/ 2 – 5 years experience)*

The results of section 6.3.3 indicate that the majority of property developers surveyed that utilise specific hurdle rates use a set of common industry accepted minimum financial metrics.

6.3.4 Determination of research question RQ 1:

RQ 1: Do Australian and New Zealand property development firms use specific go/no-go hurdle rate mechanisms as a decision basis for proceeding beyond the pre-commitment stages of the development process? What are the specific hurdle rates and benchmarks which are

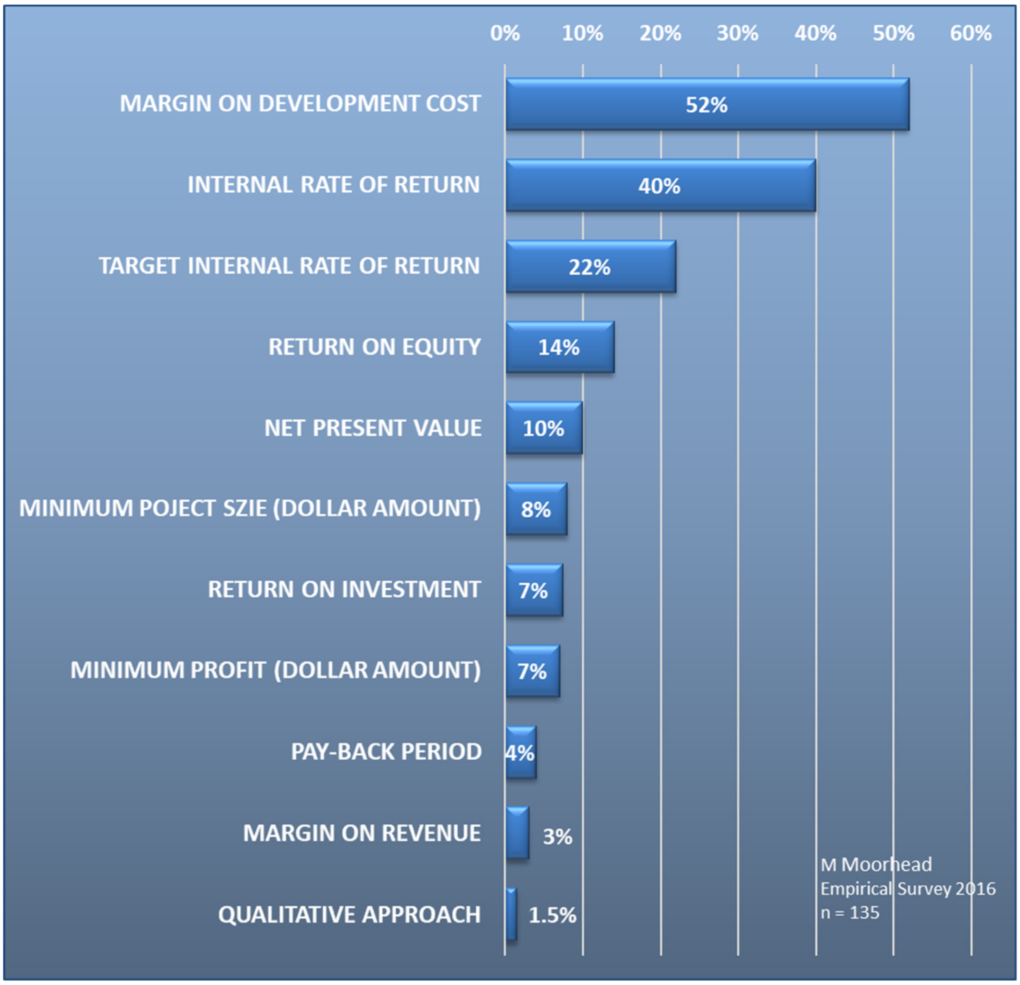
currently being used by Australian and New Zealand property development firms?

The majority (72%) of Australian and New Zealand development firms surveyed directly use specific hurdle rates as a decision-making tool in choosing whether to proceed with a project beyond the pre-commitment stages of the development process. Of those developers who do use specific go/no-go hurdle rates, approximately half (52%) use the Margin on Development Cost (MDC) as a decision-making hurdle rate as illustrated in Figure 6.3.4a.

A Chi-square test of independence was conducted and demonstrated at the 95% statistical significance level that there is an association between respondents who use hurdle rates as a decision tool and the use of MDC as a basis of that decision, χ^2 (4, n=188) = 13.20, p<.001; (see Appendix H-3). The second most frequently used (40%) metric for go/no-go hurdle rates was the Internal Rate of Return (IRR). Like the MDC, a Chi-square test of independence was conducted and demonstrated at the 95% statistical significance level that there is an association between respondents who use hurdle rates as a decision tool and the use of IRR, χ^2 (4, n=188) = 6.23, p<.013; (see Appendix H-4).

Additional tests were conducted regarding the use of specific hurdle rate metrics to gain insights into their use by survey respondents. Specifically, a number of Mann-Whitney U tests were conducted and found a significant difference in the median response for the use of a number of key hurdle rates. Firstly, the use of a minimum dollar project size requirement for projects was tested and found, at the 95% statistical significance level, that private company structured development organisations were more likely to use this hurdle rate (Md = 0.91, n = 11, U = 678.5, z = -2.112, p = .035, r = 0.16) versus other forms of organisational structure (Md = 0.59, n= 159). Secondly, a further Mann-Whitney U test found, at the 95% statistical significance level, an association between respondents who use MOR/ROR as a hurdle rate and publicly listed development organisations (Md = 0.05, n = 4, U = 199, z = -2.013, p = .044, r = 0.14), although the sample size was very small at four per cent of responses.

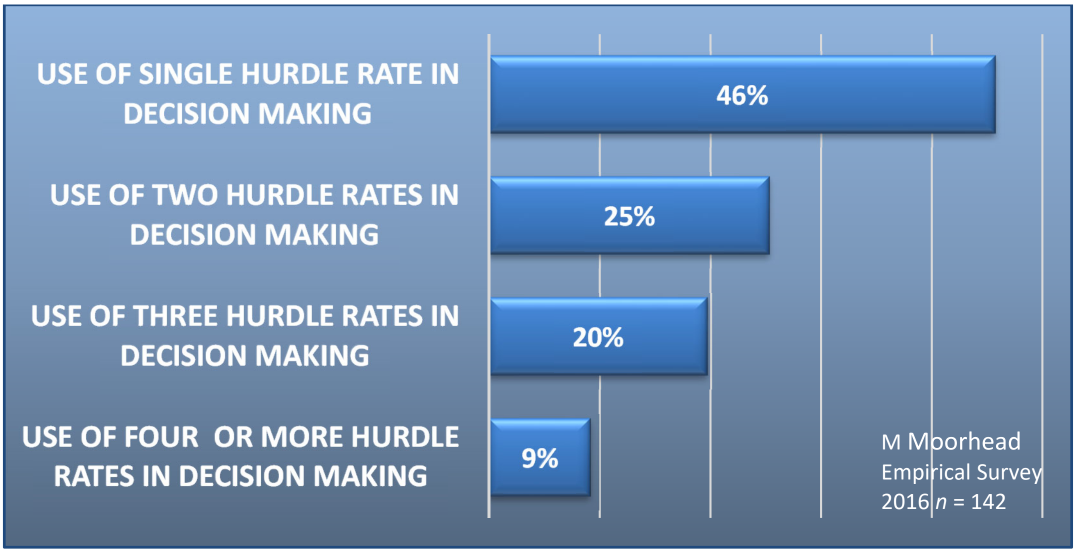
Figure 6.3.4a Respondents who use go/no-go hurdle rates as a basis of decision-making and percentage use of specific hurdle metrics



Source: Author, 2018

The survey respondents who do not use specific go/no-go hurdle rates were more likely (57%) to use a qualitative framework approach as a basis of decision-making. A Chi-square test for independence was conducted and demonstrated, at the 95% statistically significant level, that there is an association between respondents who do not use hurdle rates as a decision tool and the use of a qualitative framework as the basis of decision-making, χ^2 (4, n=188) = 81.87, p<.001; (see Appendix H-5).

Figure 6.3.4b Frequency of number specific hurdle rate metrics



Source: Author, 2018

The responses of participants from Australia were compared with those from New Zealand to determine if any statistically significant differences exist in their choice of hurdle rates and the number of hurdle rates used in decision-making. A Chi-square test of independence was conducted which indicated there were minimal differences in the choice, use and number of hurdle rates between respondents who conduct property developments in the respective national markets. It should be noted that the sample size of New Zealand organisations was small (20) and imposes a limitation upon the result. The only statistically significant results, between New Zealand and Australian based organisations, were found in that New Zealand respondents are more likely to use the *Minimum Profit* dollar amount and *Minimum Project Size* dollar amount than were

Australian based respondents. (*Minimum Profit;* χ^2 (1, *n*=185) = 10.71, *p*<.001; *Minimum Project Size* χ^2 (1, *n*=185) = 7.605, *p*<.006; see Appendix H-7).

Figure 6.3.4b represents the frequency of the number of specific hurdle rate metrics used by respondent organisations in their deciding whether to proceed, or not proceed, with projects beyond the pre-commitment stages of the development process. The majority (72%) of respondents who utilise hurdle rates in decision-making use either one or two specific hurdle rate metrics, with 45% using only one and 25% using two. Few (9) survey participant developers indicated they use four or more specific hurdle rate metrics.

Finding RQ 1:

Australian and New Zealand based property development organisations do utilise specific go/no-go hurdle rates mechanisms as a decision basis for proceeding beyond the pre-commitment stages of the development process. Specifically, Australian and New Zealand property developers use MDC and IRR as specific hurdle rate metrics to determine the go/no-go decision to proceed with a project beyond the pre-commitment stages of the development process. The majority (72%) of respondent property developers use either one or two specific hurdle rate metrics as a basis of decision making, and very few (9%) use four or more. For respondent organisations which do not use specific hurdle rates for go/no-go decision-making, they are more likely (52%) to use qualitative frameworks as a decision-making method. The results of the survey demonstrate little difference between the choice, use and the number of specific hurdle rates employed in decision-making between New Zealand and Australian based respondents.

6.3.5 Determination of research question RQ 2 a. to g.

RQ 2: What are the differences in the hurdle rates and benchmarks selection as the basis of go/no-go decisions based on the following factors:

RQ 2a: Projects by property types including residential, commercial, retail, industrial, retirement, infrastructure and mixed-use projects?

As stated in section 6.2.5, survey responses were examined along the basis of whether developers demonstrate a dominant property type in the projects they undertake. Responses were analysed from two aspects in order to address the question of whether differences exist in the selection and use of hurdle rates by developers of differing dominant property types. First, each dominant property type developer category was analysed to determine whether they use specific hurdle rates as part of a go/no-go decision basis. Second, the use of specific hurdle rates was examined as well as the specific minimum financial metric used for each respective hurdle rate.

The categories of property developers with a dominant property type were first tested for an association between the dominant property type and the use of a specific quantifiable go/no-go decision process. A Chi-Square test for independence was conducted and found that there were numerous violations of the assumption of not having less than an expected frequency of five responses for each category. Each dominant development property type category was then tested independently using either Chi-Square or Fisher's Exact to accommodate for any small expected frequencies. The results of the analysis are presented in Table 6.3.5a and found no association between dominant property type developer categories and having a go/no-go decision process (see Appendix H-7).

This result demonstrated that the various dominant property type categories of survey respondents had no significant impact on whether they use a primarily quantitative or qualitative basis for project decisions at the acquisition or commencement stages of the property development process. The dominant property type categories were then condensed to allow for residential, commercial, retail, mixed-use and other property categories to be tested for association using a Chi-Square test for independence regarding the use of key hurdle rate metrics including MDC, IRR, ROE and NPV. The reduction of industrial and other dominant developer types was due to the small sample size of these development types which were in violation of the test assumptions.

Table 6.3.5a: Chi-Square and Fisher's Exact test for independence of dominant property type and go/no-go decision processes

Chi-Square Test for Independence	*p*-value		*df*	*n* =
Residential Dominant Developer Type	0.563	Chi-square no association	1	188
Commercial Dominant Developer Type	0.240	Fisher's Exact no association	1	188
Retail Dominant Developer Type	0.777	Chi-square no association	1	188
Industrial Dominant Developer Type	0.405	Fisher's Exact no association	1	188
Tourism Dominant Developer Type	0.713	Fisher's Exact no association	1	188
Mixed-Use Dominant Developer Type	0.271	Chi-square no association	1	188
Other Property Type	0.165	Chi-square no association	1	188

Source: Author, 2018

The Chi-Square tests of independence were then completed with the condensed variable and indicated that there exists a significant association for residential developers and the use of MDC but not IRR, ROE and NPV; χ^2 (1, *n*=205) =

18.704, $p<.001$. Within the survey results, residential dominant property developers are more likely to use MDC as a hurdle rate in decision making than other dominant property types. No other associations were found between other dominant property type developer categories and the use of MDC, IRR, ROE or NPV (see Appendix H-8).

Respondent developers who indicated that they utilise a specific go/no-go decision process and also specific hurdle rates were asked to indicate the minimum acceptable project hurdle rate for each of the metrics listed in section 6.3.3 and Figure 6.3.3. The specific minimum percentage as a financial metric of the key hurdle rate metrics of MDC and IRR were investigated in regards to significant differences of respondents on the basis of dominant property type groups.

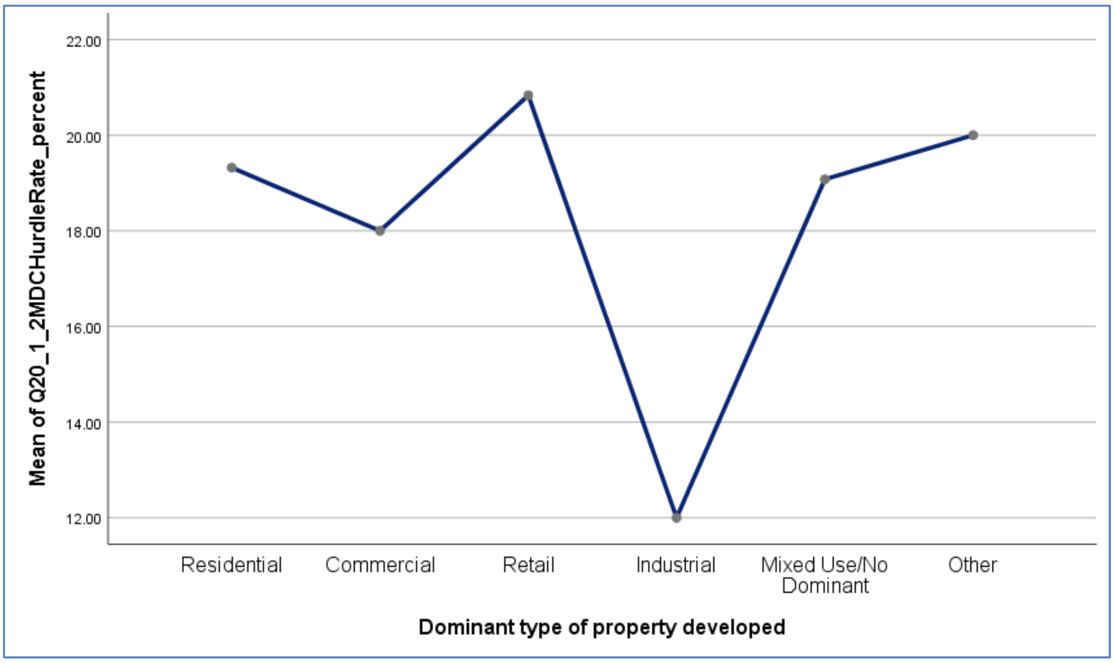
Comparison between-groups of dominant property type categories and MDC percentage.

A one-way analysis of variance (ANOVA) was conducted between-groups to investigate the required level of MDC percentage between different categories of dominant property type. There was found to be no statistically significant difference between the differing dominant property type categories: $F(5, 80) = 1.380$, $p = 0.242$ (see Appendix J-1). Figure 6.3.5a: illustrates the mean specified MDC percentage for each dominant property type category.

The mean levels of the percentage of MDC used by the residential, commercial, retail, mixed-use and other categories of dominant property type were very close to the industry standard 20% MDC hurdle rate discussed in section 6.3.3. Only the industrial dominant property type category had a mean that differed considerably at 12%, but was not found to be significant in the one-way ANOVA.

This result, regarding property developers in Australia, is in line with prior studies from other geographic regions that found a heavy reliance on intuition and rules of thumb in the decision-making practices of property developers and investors including French and Loizou (2012); Atherton *et al*. (2008), Young (2007), Sah *et al*. (2010).

Figure 6.3.5a: Mean minimum percentage of MDC for dominant property type



Source: Author, 2018

Comparison between-groups of the condensed dominant property type categories and IRR percentage.

A one-way ANOVA was also conducted between-groups to investigate the minimum required percentage of IRR between differing categories of dominant property type. There was a statistically significant difference at the $p < 0.05$ level in the mean minimum required IRR percentage between the different categories of dominant property type: $F(4, 65) = 5.453$, $p = .001$. The effect size, using an eta squared calculation, was equal to 0.27, and according to Cohen (1988, p. 284) represents a large effect as it is greater than 0.14 (See Appendix J-2).

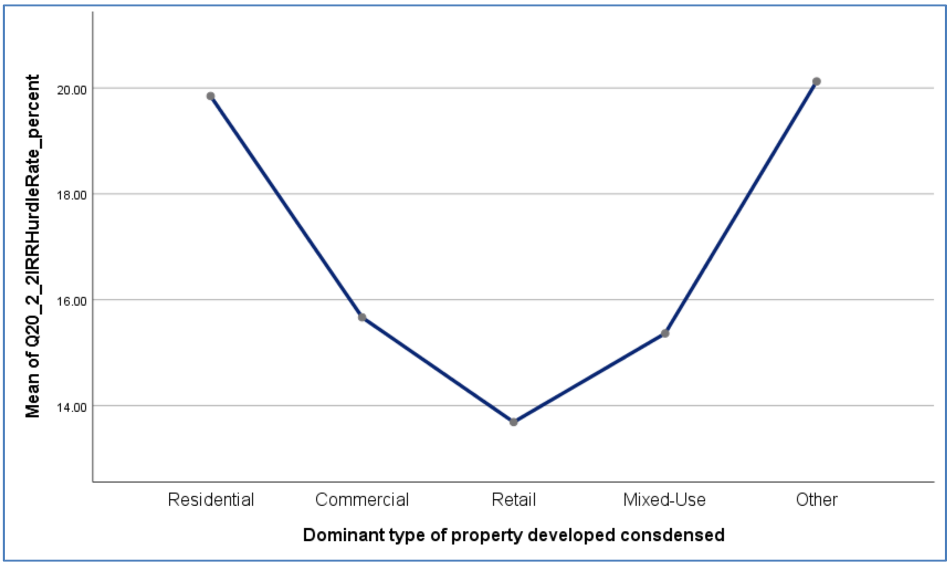
Table 6.3.5b: ANOVA comparison of the percentage of IRR as a minimum hurdle rate from dominant property type groups (condensed)

				Tukey's HSD Comparisons			
Group	*n*	Mean	*SD*	Residential	Commercial	Retail	Mixed-Use
Residential	36	19.85	4.56			.004	.027
Commercial	3	15.67	4.04				
Retail	8	13.69	3.65	.004			
Mixed-Use	11	15.36	3.44	.027			
Other	8	20.12	4.48			.030	

The mean difference is significant at the 0.05 level

The posthoc analysis using Tukey's HSD comparisons shows that the mean required IRR percentage for the residential dominant category to be higher than that of the retail and mixed-use dominant categories. Additionally, the other property dominant type category which included both industrial and childcare developer respondents was higher than that of retail and was very close to the 20%, as was the mean result of the residential dominant category. These results demonstrate that the respondent developer's perception that residential, mixed-use and the other property type categories should have a higher IRR return as a benchmark for proceeding with a project and reflect a higher required risk/reward trade-off than for retail and commercial property development projects. Figure 6.3.5b illustrates the mean IRR percentages required by each dominant property type category. One possible explanation for retail property developers having a lower required IRR is due to the propensity of these projects lasting longer than other property type development projects. The longer time-frames would lower the IRR of many projects.

Figure 6.3.5b: Mean minimum percentage of IRR for dominant property type



Source: Author, 2018

Artificial Neural Network (ANN) as a predictor of hurdle rate section of dominant property type groups

An ANN analysis was conducted on the data set using Multilayer Perceptron to analyse predictors of survey respondents hurdle rate section based upon dominant property type groups. The ranking of the importance of variables and the classification table for the training and testing of the model can be found in Appendix E-3. The results included the the variables that are the best predictors includes the decision-makers job role, the use of qualitative frameworks as a hurdle rate, the level of experience of the decision-maker, the use of specific risk-analysis methods, the educational level of the decision-maker and also whether the firm utilises a specific mechanism as the basis of a go/no-go decision in the pre-commitment stages of the development process.

Findings RQ 2a:

Differences between dominant property type categories for Australian and New Zealand property development organisations were examined across a number of dependent variables to determine differences in hurdle rate usage and specification. No significant results were found among respondents when dominant property type categories were investigated for differences in whether the category used a specific go/no-go decision process. This result demonstrated that the various dominant property type categories of respondents had no significant differences in the adoption of primarily quantitative or qualitative methods for making project decisions at the acquisition or commencement stages of the property development process. Specific hurdle rate metrics including MDC, IRR, ROE an NPV were tested to ascertain if significant differences existed in their usage among the categories of dominant property type categories. A significant difference was found in that the residential dominant developer category was more likely to use MDC as a hurdle rate metric, and no other significant results were found among the remaining dominant property type categories and the use of IRR, ROE and NPV. For those respondents who do utilise these specific financial metrics in decision-making, the actual specific minimum percentages and levels used were examined to see if significant differences exist. The results indicated there was no statistically significant difference between the differing dominant property type categories and the specific percentage of MDC adopted with a median level of 20%. This result is in line with prior relevant studies and demonstrates that the surveyed Australian and New Zealand property developers reliance on an industry rule of thumb.

However, an examination between groups regarding the specification of the percentage of IRR demonstrated that the mean required IRR percentage for the residential dominant category to be higher than that of the retail and mixed-use dominant categories. Additionally, the 'other' property dominant type category which included both industrial and childcare developer respondents was higher than that of retail and was very close to the 20% mean result of the residential dominant category. These results demonstrate the respondent developers' perception that residential, mixed-use and the other property type categories should have a higher IRR return as a benchmark for proceeding with a project and reflect a higher required risk/reward trade-off than what is required for retail and commercial property development projects. A possible explanation for the lower required IRR for retail projects is due to the extended project timeframes in comparison to the other property types thereby lowering the IRR.

RQ 2b: Projects by development company size and ownership? Publicly listed and private development companies? Large, medium-large, medium-small or small projects?

The hurdle rate selection and usage practices of respondent developers were examined in regards to their preferred project size and ownership structure. A number of tests were conducted using either a one-way ANOVA or a two-way ANOVA between groups to investigate the differences in hurdle rates practices for public versus private respondent developers and also along the basis of respondent developers' preferred project sizes. As discussed in Chapter 5, large project sizes are defined as those where the end value or gross realisation is greater than fifty million dollars (the large and medium-large projects were condensed for statistical analysis) and small project sizes are defined as less than or equal to five million dollars in end value. Medium-sized projects have an end value between that of the large and small project sizes. The hurdle rates practices investigated included the use of NPV as a hurdle rate, the specific number of hurdle rates used as a project go/no-go decision basis as well the specific percentages of MDC, IRR and ROE adopted.

Comparison between-groups of public versus private structured development organisations

The different types of ownership structure were analysed to determine if there are significantly different practices in the selection of hurdle rate, go/no-go decision processes and the risk analysis techniques adopted in determining which projects should proceed beyond the pre-commitment stages of the development process. Specifically, the practices of private company developers will be characterised against development organisations which are publicly listed on an exchange.

It was anticipated that the publicly listed organisations would have more robust decision-making practices when selecting property development projects due to the larger size, access to more resources, higher reporting requirements and market scrutiny. Table 6.3.5c lists the response numbers and percentages of each ownership category of survey respondents. For the purposes of statistical analysis this variable was also condensed into an alternative variable, entitled *Condensed Ownership Structure*, by combining the public unlisted and government categories with the other category in order to increase the minimum number of responses for each category and focus on the differences between property developer organisations which use a public or private structure. As the majority of respondents (61%) were private companies, the results may demonstrate a bias towards less sophisticated decision-making methodologies as discussed in Chapter 5 section 5.12. Hutchison *et al*. (2017, p. 7) found that, in organisations in the UK, larger publicly listed organisations were more likely to use IRR and NPV hurdle rates and smaller private companies relied more 'on subjective criteria and 'gut feel''. Preller (2009) found a similar result with the majority of respondents indicating the use of MDC, IRR and NPV by a sample of Queensland property developers, most of which were large organisations.

Table 6.3.5c: Ownership structure by the organisation of survey respondents

	Responses	Response %
Publicly Traded Company (Listed)	56	29%
Public Company (Unlisted)	8	4%
Private Company	117	61%
Government	9	5%
Other	3	2%
TOTAL	193	100%

Source: Author, 2018

A similar result was found for the use of IRR as a hurdle rate for decision-making in the pre-commitment stages of the development process, but not for the use of NPV by publicly listed developers. A Mann-Whitney U test was performed and this test confirmed a statistically significant difference (95%) for the use of IRR as a hurdle rate for publicly listed developers (Md = 0.39, n = 64) than for non-publicly listed property developers (Md = 0.25, n = 123, U = 3169, z = -2.01, p = .039, r = 0.15; see Appendix F-4).

Inversely, when private company structured property development organisations were analysed it was found that there exists a statistically significant difference (95%) for the use of IRR as a hurdle rate for non-private company developers (Md = 0.66, n = 64) than for private company structured property developers (Md = 0.51, n = 128, U = 3828, z = -2.00, p = .046, r = 0.14), indicating private company structured developers are less likely to use IRR as a decision-making hurdle rate. Additionally, it was found that private company structured companies were also less likely to incorporate specific hurdle rates in general than for non-private structured companies. This result is in line with that found by Hutchison *et al*. (2017) in that small and private companies were more likely to rely on subjective criteria. The result of the Mann-Whitney U tests found, at the 90% statistically significance level, private companies have a lower use of specific hurdle rates in decision making (*Md* = 0.57, *n* = 145, *U* = 3749, *z* = -1.65, *p* = .099, *r* = 0.12; see Appendix F-5).

As discussed in section 6.3.3 it was anticipated that the use of NPV as a decision-making hurdle rate would be high due to the prevalent recommendation and use of this financial-metric in the financial investment literature as discussed in Hutchison *et al*. (2017). However, the use of NPV was found to be only 7 per cent of survey respondents. An investigation was conducted to analyse if there was a significant difference in the use of NPV based on preferred project size and on ownership structure. Due to the small number of respondents indicating the use of NPV as a hurdle rate, the project size variable was limited to medium and large project sizes and a Fisher's Exact test was utilised to test between groups. The results indicate there was no significant association between respondents' preferred project size and the use of NPV as a hurdle rate, χ^2 (1, *n* = 157), *p* = .767; see Appendix H-9. Likewise, a Chi-square test of independence was performed, with the result indicating no significant association between the use of NPV as a hurdle rate and a condensed ownership variable including public, private or other structures, χ^2 (2, *n* = 184) = .562, *p* = .755; see Appendix H-10. The ownership variables were condensed by combining the small number of public unlisted as a category with the other to aid in the statistical analysis.

The specific levels used for MDC, IRR and ROE as well as the number of hurdle rates used in decision-making were also tested to determine differences along the basis of preferred project size. The results of these tests are presented in tables 6.3.5d and 6.3.5e respectively. A statistically significant difference was found between groups for the number of specific hurdle rates used, and also for the percentage level of ROE adopted. The percentage level specified for MDC and IRR was not statistically significant.

Table 6.3.5d: Mean, standard deviation and standard error of large medium and small project sizes and hurdle rates

		N	Mean	Std. Deviation	Std. Error
Number of specific hurdle rates	Small	25	1.40	1.26	0.25
	Medium	60	1.17	1.20	0.15
	Large	97	1.81	1.54	0.16
	Total	182	1.54	1.42	0.11
MDC percentage	Small	12	19.00	2.89	0.83
	Medium	25	20.28	3.98	0.80
	Large	43	18.79	2.97	0.45
	Total	80	19.29	3.34	0.37
IRR percentage	Small	7	18.57	3.82	1.45
	Medium	11	17.05	5.31	1.60
	Large	47	18.37	4.94	0.72
	Total	65	18.17	4.85	0.60
ROE percentage	Small	3	75.00	25.00	14.43
	Medium	6	42.50	29.79	12.16
	Large	12	24.17	9.00	2.60
	Total	21	36.67	25.56	5.58

Source: Author, 2018

Table 6.3.5e: One-way ANOVA of large, medium and small project size and hurdle rate levels

		Sum of Squares	df	Mean Square	F	Sig.
Number of specific hurdle rates	Between Groups	16.16	2	8.08	4.14	0.02
	Within Groups	348.99	179	1.95		
	Total	365.15	181			
MDC percentage	Between Groups	36.23	2	18.12	1.65	0.20
	Within Groups	844.16	77	10.96		
	Total	880.39	79			
IRR percentage	Between Groups	16.96	2	8.48	0.35	0.70
	Within Groups	1,490.68	62	24.04		
	Total	1,507.64	64			
ROE percentage	Between Groups	6,487.50	2	3,243.75	8.87	0.00
	Within Groups	6,579.17	18	365.51		
	Total	13,066.67	20			

Source: Author, 2018

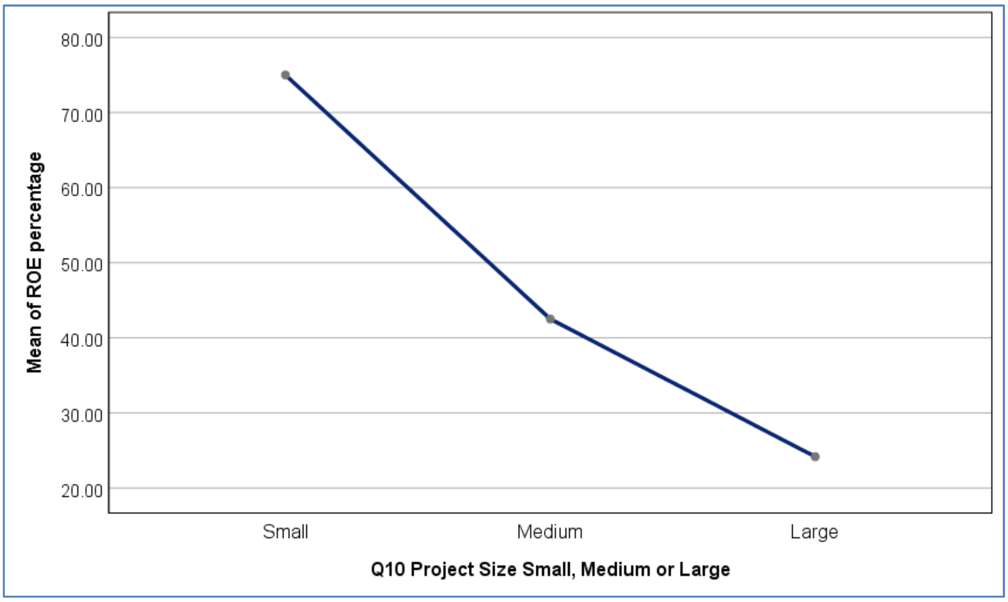
A post-hoc analysis, using Tukey's HSD comparisons, was completed and the results are given in Table 6.3.5f demonstrating that the mean required number of hurdle rates used for larger project sizes was greater than that of medium-sized projects at a statistically significant level. The mean number of hurdle rates utilised is illustrated in Figure 6.3.5c showing that those respondent developers who prefer large project sizes use more specific hurdle rates to make decision on projects beyond the pre-commitment stages of the development process.

Figure 6.3.5c: Mean number of required hurdle rates of large, medium and small project sizes

Source: Author, 2018

Additionally, Figure 6.3.5d illustrates the higher specified minimum percentage ROE of survey respondents who prefer small-sized projects. Thes result is in line with that expected as smaller property development projects often have higher levels of debt in terms of LVR percentage which necessarily increases a project's required ROE (Sharam, Bryant, & Alves, 2015). As discussed in Chapter 4, larger sized projects often have more restrictions and covenants regarding capital facility providers than those placed over smaller projects where more funding opportunities exist (Sharam, Bryant, & Alves, 2015). One explanation for this result is smaller projects have more access to debt capital which would necessarily drive up the ROE percentage required given the use of other hurdle rates such as MDC and IRR which are not as heavily influenced by project gearing. A one-way ANOVA was also conducted between-groups to investigate the minimum required percentage of ROE and the specific number of hurdle rates used by respondents in decision-making. A statistically significant difference was found, at the p <0.01 level, in the mean minimum required ROE given differing levels of hurdle rates used: $F(1, 205) = 67.763$, $p < .001$ See Appendix J-6. For respondents who use ROE, the mean number of specific hurdle rates was equal to 3.5 versus 1.15 for respondents who do not use this metric as illustrated in Figure 6.3.5e

Figure 6.3.5d: Mean required minimum percentage of ROE of large, medium and small project sizes



Source: Author, 2018

Table 6.3.5f: One-way ANOVA of large, medium and small project size and hurdle rate levels

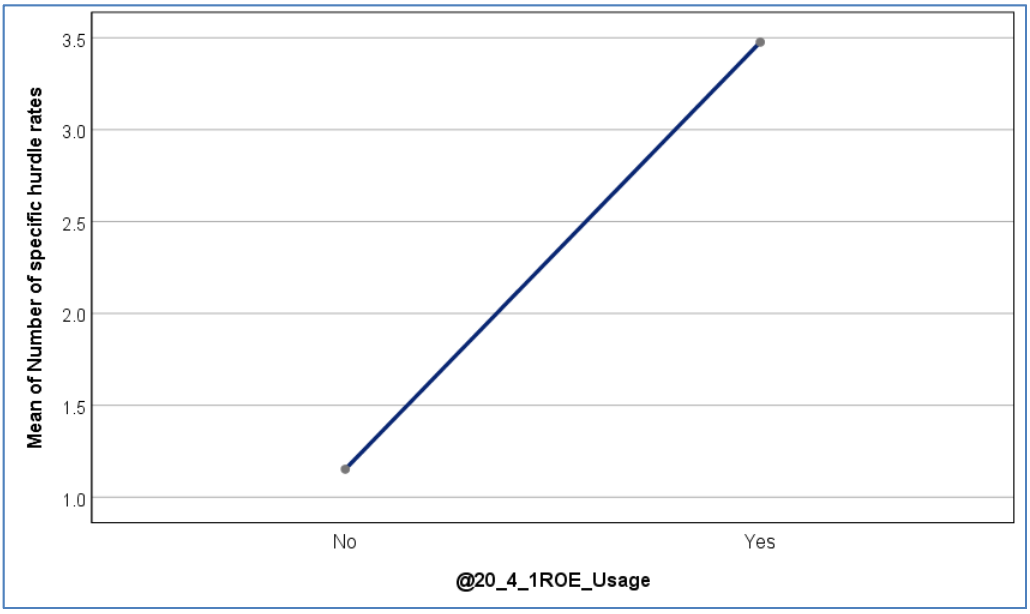
Tukey HSD Comparisons

Dependent Variable			Mean Difference	Std. Error	Sig.
Number of specific hurdle rates	Small	Medium	0.23	0.33	0.76
		Large	-0.41	0.31	0.38
	Medium	Small	-0.23	0.33	0.76
		Large	-.648*	0.23	0.01
	Large	Small	0.41	0.31	0.38
		Medium	.648*	0.23	0.01
MDC percentage	Small	Medium	-1.28	1.16	0.52
		Large	0.21	1.08	0.98
	Medium	Small	1.28	1.16	0.52
		Large	1.49	0.83	0.18
	Large	Small	-0.21	1.08	0.98
		Medium	-1.49	0.83	0.18
IRR percentage	Small	Medium	1.53	2.37	0.80
		Large	0.20	1.99	0.99
	Medium	Small	-1.53	2.37	0.80
		Large	-1.33	1.64	0.70
	Large	Small	-0.20	1.99	0.99
		Medium	1.33	1.64	0.70
ROE percentage	Small	Medium	32.50	13.52	0.07
		Large	50.83*	12.34	0.00
	Medium	Small	-32.50	13.52	0.07
		Large	18.33	9.56	0.16
	Large	Small	-50.83*	12.34	0.00
		Medium	-18.33	9.56	0.16

*The mean difference is significant at the 0.05 level

Source: Author, 2018

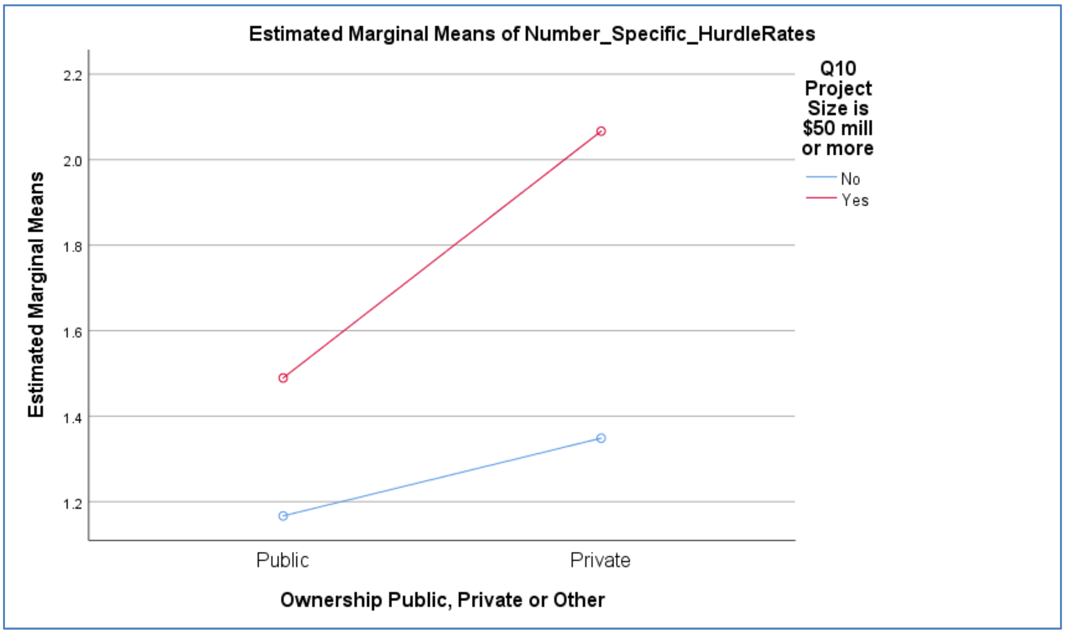
Figure 6.3.5e: Mean number of hurdle rates used and use of ROE



Source: Author, 2018

A two-way ANOVA between groups was conducted to examine the difference in the number of hurdle rates used as a project go/no-go decision basis for public versus private developers as well as whether they undertake large project sizes (>50 million dollars). The interaction effect between respondent developers who undertake large project sizes and whether they are public or private in nature was not statistically significant, $F(1, 170) = .566$, $p = 0.453$ (See Appendix J-3). However, a statistically significant result was found, at the $p < .05$ level, for developers who undertake large projects and the use of a higher number of hurdle rates as a basis for proceeding with a project, but the effect size was considered small, $F(1, 170) = 3.919$, $p = 0.049$, partial ETA Squared = .023 (See Appendix J-3). Figure 6.3.5f: illustrates the mean number of specific hurdle rates used between groups of both public and private respondent developers and large project sizes.

Figure 6.3.5f: Mean number of specific hurdle rates used between groups of private and public developers and large project sizes.



Source: Author, 2018

As discussed in section 2.4.2, there has been very little research conducted regarding the decision-making practices of small property development organisations. One-way ANOVA's were conducted to test for differences between groups of small developers (project size <= 5 million dollars) and the specific use and percentage level applied of MDC, IRR and ROE, with no statistically significant results found at the $p < .05$ level (See Appendix J-5).

Direct binary logistic regression was also conducted to ascertain the impact of key variables on the likelihood that respondent developers who undertake larger projects would incorporate more sophisticated and complex quantifiable decision-making methodologies for deciding whether to proceed with a project. The model contained ten independent variables (Q14 Specialised Board or Other must approve all decisions to commit to a project; Q18 Specific Go /No-Go

Processes; Q19 Utilises Specific Hurdle Rates; Q19a Number of Hurdle Rates Incorporated; Q20_11 Utilises Qualitative Frameworks; Q23_1 - 3 Types of Feasibility Methods Adopted; Q27 Number of Risk Analysis Methods; Q31 Risk Tolerance Scale). The model was completed over 5 steps to incorporate all the predictors, $\chi 2$ (6, N = 164) = 41.89, $p < 0.001$, indicating that the model was statistically significant and was able to distinguish between developers that undertake large projects (>= $50 million) and developers whose projects are smaller (< $50 million). The model as a whole explained between 22.5% (Cox and Snell R square) and 30.1% (Nagelkerke R Squared) of the variance in developer project size, and correctly classified 71.3% of cases.

As demonstrated in Table 6.3.5g and in Appendix I-2, 7 of the independent variables made a unique statistically significant (95% confidence level) contribution to the model (Q18 Specific Go-No Go Processes; Q14_0 No Decision Maker; Q14_1 Other Approval Type; Q14_2 Board Approval; Q19 Utilises Specific Hurdle Rates; Q20_11 Utilises Qualitative Frameworks; Q23_3 Feasibility Method – residual accumulation cash flow method). All but one of the significant variables had a positive *B* value, except the for use of the residual cash flow accumulation method indicating that larger project developers are less likely to use this indicator. The strongest indicator as a predictor of larger project size was whether board approval is required to commit to a project (12.780 odds ratio) indicating just under 13 times more likely, controlling for all other factors in the model. An additional strong indicator included whether the organisation utilised qualitative frameworks as a decision-making requirement (11.748 odds ratio) indicating just under twelve times more likely to undertake large projects (> $50 million), controlling for all other factors in the model. It is also notable that property developers that undertake larger projects are four times (4.125 odds ratio) more likely to have a formalised go/no-go decision-making process.

Given the overall significance of the model at the 99% confidence level, the results demonstrate property developers who undertake larger projects have more complex and sophisticated decision-making systems and utilise more complex and robust feasibility methods.

Table 6.3.5g: Binary logistic regression as a predicter of developers who undertake large project sizes

Binary Logistic Regression -Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 5[e]	Q18 GO/NO-GO Decision Basis	1.417	.707	4.014	1	.045	4.125
	Q14_1BoardorOther_R			14.370	2	.001	
	Q14_1BoardorOther_R(1)	2.025	.746	7.376	1	.007	7.576
	Q14_1BoardorOther_R(2)	2.548	.682	13.939	1	.000	12.780
	Q19 Specific hurdle rate use	1.358	.554	6.012	1	.014	3.889
	Q20 -11 Qualitative Hurdle Rate Approach	2.464	.837	8.656	1	.003	11.748
	Q23-Residual Cashflow Accumulation Method	-1.605	.753	4.547	1	.033	.201
	Constant	-4.561	1.053	18.751	1	.000	.010

e. Variable(s) entered on step 5: Q18 GO/NO- GO Decision Basis.

Source: Author, 2018

Findings RQ 2b:

The results of the analysis demonstrate that developers who undertake large project sizes do utilise more sophisticated methods of feasibility analysis and have a higher number of specific hurdle rates as a basis for project selection and proceeding beyond the pre-commitment stages of the development process. The result is in line with what was expected, as those that undertake larger projects typically have more capital at risk and it was anticipated that more resources would be dedicated to the determination of project viability. However, ownership structure, and particularly public versus private structures, did not influence the respondent developers' choice and the number of hurdle rates used as a decision basis. It was anticipated that publicly listed developers would use more specific financial metrics, both in number and complexity, in order to determine project viability, but this was not found to be true for the survey respondents. The results also demonstrate that developers who undertake smaller projects adopt a higher percentage of ROE as a hurdle rate. One explanation for this result is that smaller projects have more access to debt capital which would necessarily drive up the ROE percentage required given the use of other hurdle rates such as MDC and IRR that are not as heavily influenced by project gearing. Additionally, a strong association was found between the use of ROE as a hurdle rate and using multiple hurdle rates in decision-making, indicating this was a secondary hurdle rate metric in addition to the use of MDC or IRR. For respondents that use ROE, the mean number of specific hurdle rates was 3.5 versus 1.15 for respondents who do not use this metric.

The results found only a small incidence of use of NPV as a project decision-making hurdle rate, and preferred project size and ownership structure had no significant association with the use of this hurdle rate. This result was surprising given the prominence of NPV in the financial decision-making academic literature.

Project size also influenced the respondent developer's use of IRR as a hurdle rate, although preferred project size and ownership structure had no significant association on the specific percentage level adopted. No association was found between preferred project size and ownership structure, as well as the use and specific percentage level of MDC as a hurdle rate.

RQ 2c: Projects by developer motive? Speculative or trader developers versus develop and hold/investor developers?

As discussed in section 2.4 it is common to separate developers into typologies based upon the primary rationale for undertaking a project. The developer types discussed in section 6.2.2 were condensed to remove the effect of valuation firms and other organisations leaving the typologies of trader developer, investor developer and development managers. The developer typologies were also investigated to ascertain key differences in the number of hurdle rates used and the use of use of MDC, IRR and ROE as well as the specific percentages adopted. Table 6.3.5h lists the results of thirteen Chi-Square tests for independence which were conducted to test for association between developer typologies and the use of specific hurdle rates as well as the use of go/no-go decision making. The results demonstrate the following aspects (See Appendix H-2):

- Trader developers have a statistically significant higher usage of MDC as a hurdle rate and also are more likely to use specific hurdle rates as part of a decision process whether to proceed with a project.
- Development managers have a statistically significant higher usage of MDC as a hurdle rate than do investor developers.
- Investor developers have a statistically significant higher usage of payback period as a hurdle rate than do trader developers and development managers.

These results are not surprising, as it was expected that developer typologies which are more speculative in nature would rely on simpler ratios of profit to cost and investor developers would use hurdle rates that account for the time value of money.

Table 6.3.5h: Results of Chi-Square test of independence of developer typologies and specific hurdle rates used and using a go/no-go decision process

Chi-Square Test for Independence	*p*-value		*df*	*n =*
Q18 Using go/no-go decision making	0.643	Chi-square no association	1	151
Q19 Incorporates specific hurdle rates	0.018	Chi-square showing association	2	151
Q20:1 MDC hurdle rate usage	0.030	Chi-square showing association	2	153
Q20:2 IRR hurdle rate usage	0.180	Chi-square no association	2	154
Q20:3 TIRR hurdle rate usage	0.585	Chi-square no association	2	153
Q20:4 ROE hurdle rate usage	0.324	Chi-square no association	2	153
Q20:5 NPV hurdle rate usage	0.33	Chi-square no association	2	153
Q20:6 Minimum dollar profit usage	0.835	Cramer's V no association	2	153
Q20:7 Minimum dollar project size	0.685	Cramer's V no association	2	153
Q20:8 ROI hurdle rate usage	0.864	Cramer's V no association	2	153
Q20:9 Payback period hurdle usage	0.039	Cramer's V showing association	2	153
Q20:10 MOR hurdle rate usage	0.641	Chi-square no association	2	153
Q20:11 Qualitative hurdle rate approach	0.315	Chi-square no association	2	153

Source: Author, 2018

A one-way ANOVA between groups was also conducted to explore the impact of developer typologies and the selection and use of hurdle rates in decision-making, the results of which are presented in Table 6.3.5i, Table 6.3.5j and Table 6.3.5k. A statistically significant difference was found, at the $p < .05$ level, in the percentage IRR adopted, but did not find a difference in the number of hurdle rates used or in the MDC or ROE percentage specified (See Appendix J-4).

Table 6.3.5i: Mean, standard deviation and standard error of developer type (condensed) and hurdle rate levels and numbers used

		N	Mean	Std. Deviation	Std. Error
Number of specific hurdle rates	Trader Developer	71	1.66	1.07	0.127
	Investor Developer	31	1.71	1.87	0.335
	Development Manager	51	1.22	1.47	0.206
	Total	153	1.52	1.41	0.114
MDC percentage	Trader Developer	40	19.93	3.81	0.602
	Investor Developer	12	18.67	3.77	1.089
	Development Manager	17	18.71	1.99	0.483
	Total	69	19.41	3.45	0.416
IRR percentage	Trader Developer	31	19.48	4.93	0.885
	Investor Developer	11	15.23	4.36	1.313
	Development Manager	13	17.96	4.82	1.338
	Total	55	18.27	4.99	0.673
ROE percentage	Trader Developer	8	39.38	27.05	9.564
	Investor Developer	5	34.00	31.50	14.089
	Development Manager	3	41.67	24.66	14.240
	Total	16	38.13	26.39	6.597

Source: Author, 2018

The results demonstrate a statistically significant difference, at the $p < 0.05$ level, in the percentage of IRR adopted by Trader Developers as being higher than that of Investor Developers or Development Managers. The adopted percentage of MDC, ROE and the number of specific hurdle rates used in decision-making was not statistically significant.

Table 6.3.5j: One-way ANOVA of developer type (condensed) and hurdle rate levels showing differences between groups

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Number of specific hurdle rates	Between Groups	7.27	2	3.63	1.86	0.16
	Within Groups	292.90	150	1.95		
	Total	300.17	152			
MDC percentage	Between Groups	25.67	2	12.83	1.08	0.35
	Within Groups	784.97	66	11.89		
	Total	810.64	68			
IRR percentage	Between Groups	148.75	2	74.38	3.23	0.05
	Within Groups	1196.65	52	23.01		
	Total	1345.41	54			
ROE percentage	Between Groups	135.21	2	67.60	0.09	0.92
	Within Groups	10308.54	13	792.96		
	Total	10443.75	15			

Source: Author, 2018

Table 6.3.5k: One-way ANOVA of developer type (condensed) and hurdle rate levels showing mean, standard error and significance

Tukey HSD

Dependent Variable			Mean Difference	Std. Error	Sig.
IRR percentage	Trader Developer	Investor Developer	4.26*	1.68	0.038
		Development Manager	1.52	1.59	0.605
	Investor Developer	Trader Developer	-4.26*	1.68	0.038
		Development Manager	-2.73	1.97	0.353
	Development Manager	Trader Developer	-1.52	1.59	0.605
		Investor Developer	2.73	1.97	0.353

*The mean difference is significant at the 0.05 level.

Source: Author, 2018

Findings RQ 2c:

The results of the analysis demonstrate that differences exist among survey respondents in the selection and use of hurdle rates along based on developer typologies. Investor Developers are more likely to use the payback period as a hurdle rate and Trader Developers and Development Managers are both more likely to use MDC and also to use specific hurdle rates as a part of a go/no-go decision. Additionally, Trader Developers surveyed adopt a higher percentage of IRR as a metric than do the other key developer typologies which may reflect the higher level of risk inherent in the more speculative nature of the development process for Trader Developers than for Investor Developers. It is also relevant to note that Trader Developers deviated further from accepted financial theory in hurdle rate selection than did Investors Developers.

RQ 2d: Does experience influence hurdle rate selection? Test differences between experienced versus novice decision-makers.

As discussed in section 6.3.5, further analysis was conducted concerning the differences between respondents of differing experience in years and the selection and use of specific hurdle rate metrics. The four levels of experience as shown in Table 6.2.6 included respondents having more than ten years' experience, having 5 - 10 years' experience, having 2 – 5 years' experience and having fewer than two years' experience. The years of experience does not indicate workforce or industry experience but is concerned with the experience in the decision-making process of deciding whether to proceed with potential projects. It was anticipated that experience would demonstrate a significant difference among respondents in their choice and specific levels of hurdle rates adopted. Due to the experience levels being divided into four groups, a non-parametric Kruskal-Wallis H test was performed, and this test revealed no statistically significant difference between groups based on the respondent's experience levels and whether they use a go/no-go decision basis, the use of specific hurdle rates or in the usage of the MDC, IRR, or ROE hurdle rates as shown in table 6.3.5l (See Appendix F-12).

Table 6.3.5l: Kruskal-Wallis H test of experience levels and hurdle rate usage

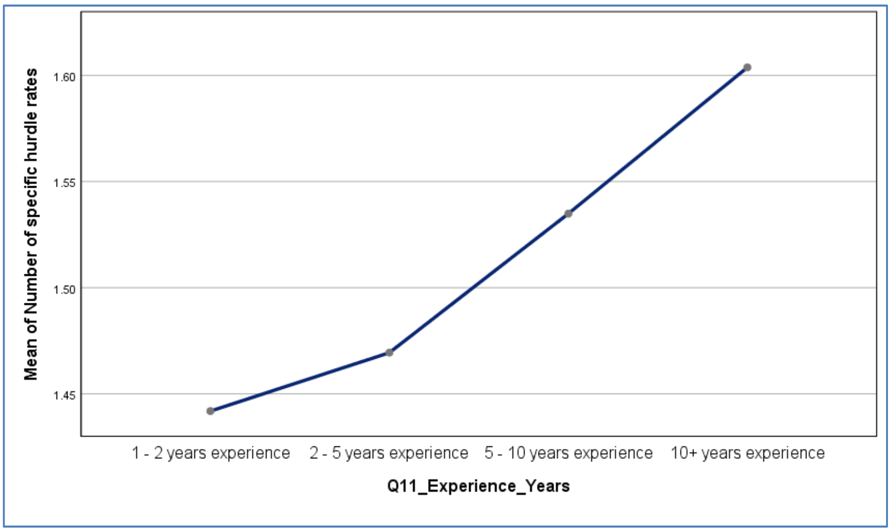
Variable Tested	1-2 years	2-5 years	5-10 years	+10 years	Kruskal-Wallis H	df	*p-value*
Q18 go/no-go decision basis	*n* = 43	*n* = 49	*n* = 43	*n* = 53	4.38	3	0.223
Q19 Use of specific hurdle rates	0.00	0.000	0.000	0.00	0.42	3	0.935
MDC Usage	0.00	0.000	0.000	0.00	1.44	3	0.697
IRR Usage	0.00	0.000	0.000	0.00	1.63	3	0.652
ROE Usage	0.00	0.000	0.000	0.89	0.78	3	0.855
Total *n* = 188							

Source: Author, 2018

Additional tests were conducted using a series of one-way ANOVAs to determine if there were significant differences in respondents experience levels and the number of variables forecasted, the specific number of hurdle rates used as well as the specific levels adopted for each. The results of the analysis demonstrate that respondent developers did not demonstrate significant differences along the basis as illustrated in Figure 6.3.5g and Figure 6.3.5h showing the mean number of hurdle rates used as well as the mean number of variables forecasted across different experience levels changed by only 0.15 and 1.1 respectfully across levels (see Appendices J-8).

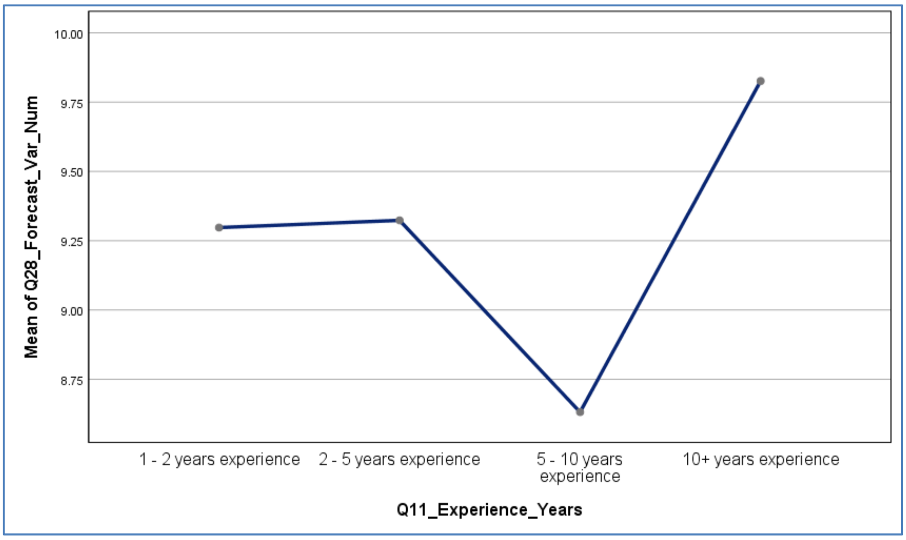
This result is different to that which was found by Sah *et al*. (2010) which found significant differences between decision-making practices of respondents setting property investment hurdle rates, and particularly a large difference in the number of variables forecasted to aid in the decision-making process. This result may indicate that property development organisation respondents have a defined method of conducting a feasibility analysis and making decisions in a prescriptive manner. This is an area that should be investigated in further research.

Figure 6.3.5g: Mean number of hurdle rates used across experience levels



Source: Author, 2018

Figure 6.3.5h: Mean number of variables used in forecasting across experience levels



Source: Author, 2018

Findings RQ 2d:

The results of the analysis demonstrate that respondent developers did not differ between groups of experienced versus novices in their use of go/no-go hurdle rates, the usage or specific levels of key hurdle rates, the number of hurdle rates used or in the number of variables forecasted to aid in decision making based on their experience levels. These results were different from that which was anticipated and is an area for further research.

The results of the analysis demonstrated, among survey respondents, that there were no differences between experienced versus novices in terms of their use of go/no-go hurdle rates, the usage or specific levels of key hurdle rates, the number of hurdle rates used or in the number of variables forecasted to aid in decision-making based on experience levels. These results were different from those anticipated and is an area for further research.

RQ 2e: Do decision-makers with a specific property-related degree differ in hurdle rate selection and use?

The decision-making practices which includes using a consistent go/no-go decision basis, the use of specific hurdle rates in decision making as well as the usage of MDC, IRR and ROE were tested for association between respondents who have a property qualification and those who do not by using a Chi-Square test for independence. The results of the analysis demonstrated no association, at the $p < 0.05$ level, of the dependent variables between respondents who do or do not have a property qualification (see Appendix H-11). However, an association was found, at the $p < .10$ level, between groups of survey respondents with a property qualification, demonstrating they are more likely to use specific hurdle rates to make project decisions, χ^2 (1, n=181) = 3.06, p=.08, (see Appendix H-11).

The linkage between education level, experience and having a property related qualification

An investigation was made to determine if there was a significant association between survey respondents' education level and having a property related qualification. A Chi-square test for independence was conducted and demonstrated, at the $p < .05$ level, an association between education level and obtaining a property degree qualification, χ^2 (4, n=182) = 12.07, p<.017; (see Appendix H-1). The analysis demonstrates that decision-makers for potential projects within property development organisations who do have a university degree are more likely to have a property-specific qualification. This result would support the common industry view, held over the past two decades, that the emergence of property related degrees has created the primary pathway to project management within property development organisations. Additionally, a non-parametric test of two independent samples was conducted to determine if a significant difference exists in the mean years of experience between survey respondents having a property degree qualification and those without. The result of the test revealed no statistically significant result, at the $p < 0.05$ confidence level (p = 0.793; See Appendix G-4).

Findings RQ 2e:

The results of the analysis demonstrate that, that in terms of hurdle rate selection and usage, there was little difference in respondent developers who have a property qualification and those who do not, except for being more likely to use specific hurdle rates in their decision-making processes. A statistically significant result was found between survey respondents education level and having a property qualification. Likewise, the association between the mean years of experience and having a property related qualification found no significant association.

RQ 2f: Are there significant differences in hurdle rate selection and use between the different geographic regions of Australia and New Zealand?

A series of Chi-Square tests for independence were conducted to determine if there was an association in the decision-making processes and hurdle rate usage of Australian versus New Zealand respondent property developers. The results of the analysis demonstrate that there were no significant differences between property developer respondents from Australia and New Zealand along the following basis (See Appendix H-6):

- Go/no-go decision processes
- Use of specific hurdle rates
- Number of hurdle rates used
- Number of variables forecasted in the decision process
- Use and specific level of MDC
- Use and specific level of IRR
- Use and specific level of ROE.

Findings RQ 2f:

Only a small number of respondents (n = 14) from New Zealand indicated that they use specific hurdle rates as part of their decision process, but the small sample size has been addressed through the statistical methods adopted. However, this result is in contrast to Australian developer respondents (n= 170) where the majority do use specific hurdle rates Additionally, the results of the analysis demonstrated that for those in Australia and New Zealand who do use specific hurdle rates in decision-making, significant differences were not found with the exception of New Zealand based property developers who were more likely to use the *Minimum Profit* dollar amount and *Minimum Project Size* dollar amount than were Australian based property developers.

RQ 2g: Are there significant differences in hurdle rate selection and use between projects by multi-national development companies operating in multiple countries?

Survey respondent development organisations which operate projects in multiple countries were examined in relation to their hurdle rate selection and usage. A non-parametric Mann-Whitney U test was conducted on this group with test variables that included all hurdle rates presented in the survey as well as differing feasibility analysis methods as dependent variables. The results of the tests found a lower usage of MDC as a project hurdle rate for multinational developers ($Md = 0.08$, 13) than for developers who operate in a single nation ($Md = -0.43$, $n = 190$, $U = 804$, $z = -2.478$, $p = .013$, $r = 0.17$). As discussed in Chapter 3, the MDC or ROC has been found to be the most common hurdle rate used for project evaluation in many prior studies including Crosby *et al*. (2018a), Hutchison, 2017, IPD (2010), Costello and Preller (2010).

Additionally, it was found that multinational developers were more likely to utilise a qualitative hurdle rate approach ($Md = 0.38$, $n = 13$) than for developers who operate in a single nation ($Md = -0.14$, $n = 190$, $U = 936$, $z = -2.316$, $p = .021$, $r = 0.16$). The usage of all other hurdle rates and feasibility methods were not found to be different at the 95% statistically significant level. This result demonstrates that those firms that operate across multiple-national markets need to incorporate more flexible and complex decision-making practices than the simpler MDC rule that is often applied to domestic developers (see Appendix F-3).

Findings RQ 2g:

Survey respondents that represent multi-national property development organisations operating in multiple geographic regions demonstrated a higher use of qualitative frameworks as a decision-making process and a lower use of MDC as a hurdle rate. This result is the opposite of that given by Australian and New Zealand survey respondents operating in their domestic markets. Additionally, this result demonstrates that those firms that operate across multiple-national markets need to incorporate more flexible and complex decision-making than developers operating in a single market.

6.3.6 Hurdle rate adjustment, heuristic bias and bounded rationality

Research questions **RQ 5** and **RQ 6** examine the relationship between the choices and selection of hurdle rates and the methods respondents use to alter these hurdle rates as well as exploring the notion of heuristic bias and bounded rationality in decision practices. Due to the subject matter of these questions, they will be discussed in section 6.3 prior to considering research questions **RQ 3** and **RQ 4** which are addressed in section 6.4 and examine the feasibility practices of respondent organisations.

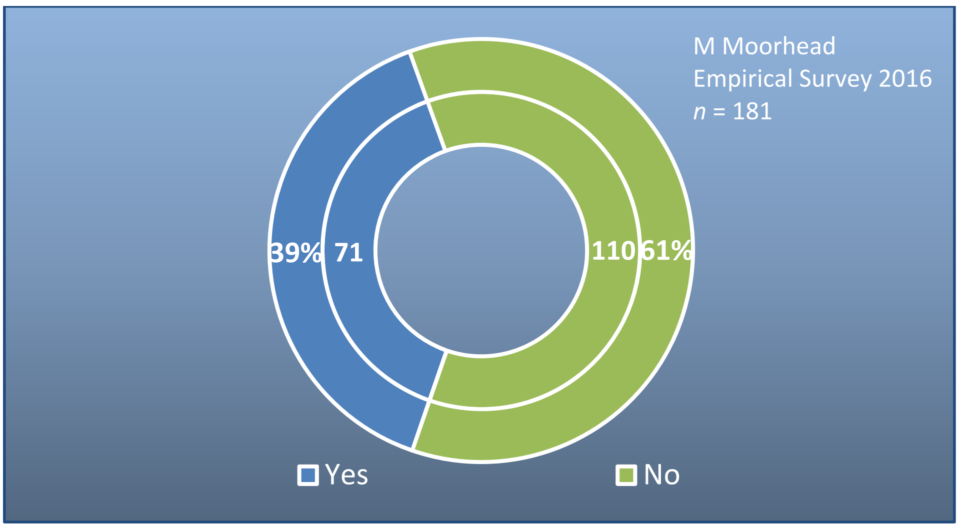
6.3.7 Determination of research question RQ 5:

RQ 5: Do development companies have a pre-determined process and method of altering or adapting the chosen hurdle rates and benchmarks? How do Australian and New Zealand property development organisations specify and change the required hurdle rates and benchmarks as a basis of go/no-go decisions in light of increased risk and uncertainty?

The two questions represented in **RQ 5** were designed to gain an understanding of how property developers in Australia change specific hurdle rates or alter the financial metric used, and also to gain insights into how they may do so in light of an increase in uncertainty for a proposed project. The majority (61%) of Australian and New Zealand development firms surveyed indicated that they do not have a pre-determined process or method of altering or adapting hurdle rates and benchmarks and 39% indicated that they do have a pre-determined process as illustrated in Figure 6.3.7a.

Survey respondents who indicated that they specify and change the required hurdle rates and benchmarks as a basis of a go/no-go decision in light of increased risk and uncertainty were asked to specify the mechanisms used for altering financial-based hurdle rates in their decision-making practices. There was a total of 69 responses to this open-ended qualitative question, out of a possible seventy-one responses, asking respondents to describe the process or method of altering or adapting the chosen hurdle rates and benchmarks which represents a 97% response rate.

Figure 6.3.7a: Responses to having a pre-determined method of altering and adapting hurdle rates and benchmarks

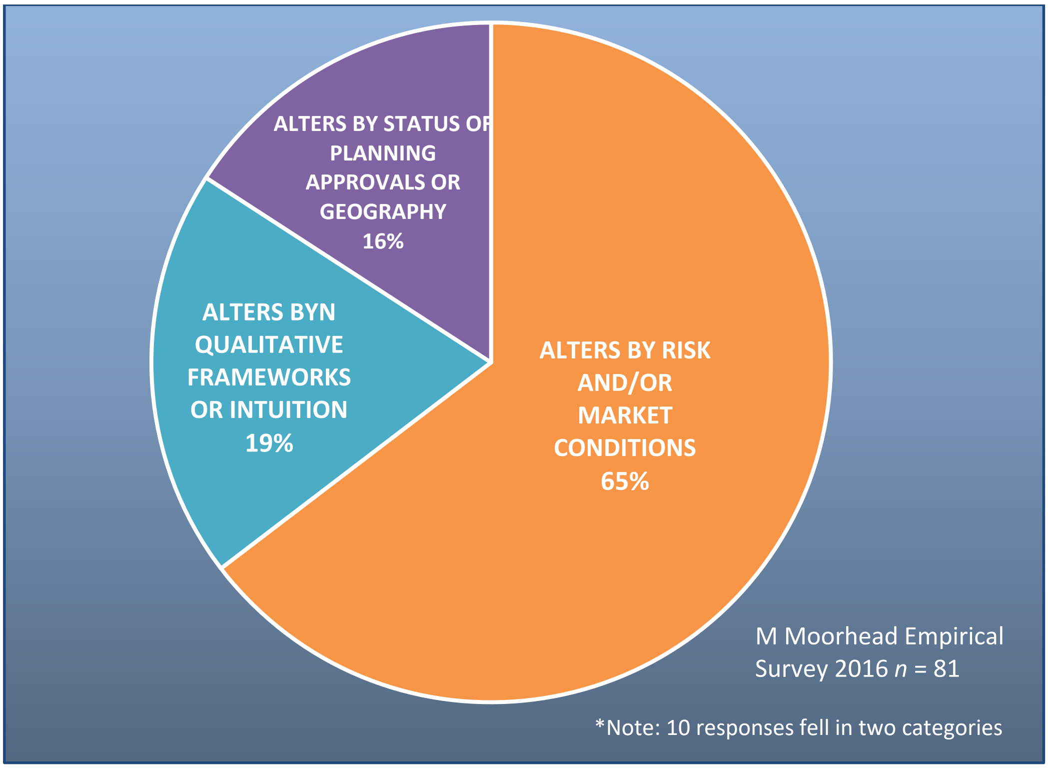


Source: Author, 2018

As discussed in section 5.4 and described in Sunders *et al*. (2009) the qualitative open-ended responses were quantitised into themes to allow for quantitative analysis to be conducted. Three main themes emerged which were coded as the following:

- Alters hurdle rates on the basis of risk analysis and market conditions
- Alters hurdle rates on the basis of qualitative frameworks or intuition
- Alters hurdle rates on the basis of the status of planning approvals or geographic regions.

Figure 6.3.7b: Results of quantitising open-ended questions into themes based on the rationale for altering hurdle rates



Source: Author, 2018

Figure 6.3.7b illustrates the percentage frequency of each of the three main identified themes. The largest theme (65%) was based on the results of the risk analysis methods or in light of an expected change in market conditions. This theme was anticipated in the results and is considered to be one of the primary purposes of conducting a risk analysis as part of the feasibility analysis process for determining project viability.

Specific examples of responses found within this theme are given as follows:

> *Example 1: In terms of risk:*
> *1) If pre-sales are in place at the time of acquisition, sales risk is lower and therefore a lower ROC could be approved.*
> *2) Higher return on cost (on longer projects) could result in approving a lower project IRR as your risk profile is reduced.*
> *(Senior Development Manager / Large Development Project Size/ Primary Residential Type/ Private Company/ 10+ years experience)*
>
> *Example 2: We use PERT risk profiling (statistical analysis and Monte Carlo profiling with frequent updates across the project lifecycle.*
> *(General Manager / Large Development Project Size/ Mixed-Use Development Type/ Private Company/ 10+ years experience)*
>
> *Example 3: During uncertain economic times or difficult development scenarios, we aim for a higher POC. We also produce a table to compare various scenarios i.e. if back end sales drop $250/sqm, $500/sqm or $1000/sqm, or similarly, if the build cost blows out, and make an informed decision accordingly.*
> *(Development Manager / Medium-Large Development Project Size/ Primary Residential Type/ Private Company/ <5 years experience)*

> *Example 4: Anticipated changes in market conditions may alter our specific return requirements for the project. This is project and outcome-specific however and would not be as relevant in a single-stage short-term development. Our return requirements are also dependent on the length of planned asset ownership. In any event, all of our hurdle rates are decided on a project-specific basis according to the level of de-risking available for that project.*
> *(Senior Development Manager / Medium-Large Development Project Size/ Primary Retail Type/ Private Company/ 10+ years experience)*

> *Example 5: Dependent on investor return requirements and elements such as liquidity, forecast market growth, investment hold period, entry and exit strategy. We work with an independent Risk and Quantitative analysis team who would assist in setting the thresholds of this alteration.*
> *(Development Manager / Large Development Project Size/ Primary Commercial Type/ Publicly Listed Company/ 5 – 10 years experience)*

The second most used theme (19%) was altering hurdle rates as part of an iterative qualitative process or on the decision-makers intuition. This result is also not surprising. As identified in Chapter 3, intuition is a common method of decision-making in the property development industry, and organisations often have a qualitative iterative process of reviewing potential project acquisitions by senior managers, company boards and risk committees as part of their approval process for progressing beyond the pre-commitment stages of the development process.

Specific examples of responses found within this theme include:

Example 1: We typically take a subjective risk view of the markets. Eg. Do we feel the markets will soften at all (sales rates or revenues per product)? If so, we will increase our hurdles to try and mitigate the perceived risks.
(Senior Development Manager / Medium-Large Development Project Size/ Mixed-Use Development Type / Private Company/ 10+ years experience)

Example 2: Yes, we will alter financial base rates and have in the past proceeded with projects providing sub 15% returns, if we perceive the project to be particularly low risk. For example, if it is a small project that we know we can sell quickly, has relatively straightforward planning requirements and can be completed in a short space of time (i.e., 18 months from site identification to settling down a completed stock), then we will often be willing to accept lower returns. As in all business, the level of return must correlate directly to the level of risk, and the same applies to property development.
(Development Manager / Medium-Small Development Project Size/ Primary Residential Type/ Private Company/ 5 -10 years experience)

Example 3: We adopted a layered approval process where decisions are made to reduce or increase metrics depending on project specifics.
(Development Manager / Large Development Project Size/ Primary Commercial Type/ Publicly Listed Company/ 10+ years experience)

The third most used theme (16%) was altering hurdle rates on the basis of the status of the project's development approval or on a geographic basis. This result was unexpected and demonstrates that the emergence of planning risk is a basis for setting project parameters.

Specific examples of responses found within this theme include:

Example 1: A change in zoning or delivery of infrastructure that delivers project certainty and de-risks project assumptions will be used as a basis for reviewing hurdle rates.
(Senior Development Manager / Large Development Project Size/ Primary Residential Type/ Publicly Listed Company/ 10+ years experience)

Example 2: Hurdle rates are dependent on risk and if planning permits are in place at the time of acquisition a lower return on cost could be approved.
(Senior Development Manager / Large Development Project Size/ Primary Residential Type/ Private Company/ 5 -10 years experience)

Example 3: Development approval status and market justification for a change of rate supported by external feasibility reports.
(Development Manager / Medium-Small Development Project Size/ Primary Residential Type/ Private Company/ 5 -10 years experience)

Example 4: Adopting lower hurdle rates dependent on the status of approvals, the volume of pre-sales, completed stages/balance land etc. When the risk profile falls, then it is reasonable for the risk premium applied to a financial model to also fall.
(General Manager / Large Development Project Size/ Residential Development Type/ Private Company/ 10+ years experience)

Artificial Neural Network (ANN) as a predictor of respondents use of a mechanism for adjusting hurdle rates

An ANN analysis was conducted on the data set using Multilayer Perceptron to analyse predictors of survey respondents who use a specific mechanism for altering or adjusting hurdle rates given a change in expected uncertainty across many of the key survey demographic variables and the ranking of the importance of variables and the classification table for the training and testing of the model can be found in Appendix E-4. The results indicate that the most important variables as predictors of having a specific mechanism for altering hurdle rates includes the developer type, type of property developed, education level and whether the respondents use MDC and IRR as a hurdle rate, and the normalised importance of each of these variables is given in Table 6.3.7.

Table 6.3.7: Results of ANN as a predictor of altering hurdle rates

Independent Variable Importance

	Importance	Normalized Importance
Q5_Developer_Type	0.076	100.00%
Dominant type of property developed condensed	0.061	80.00%
Q12_Edcucation_Level_R	0.059	78.50%
Q20_2_1IRR_Usage	0.057	75.20%
Q20_1_1MDC_Usage	0.056	74.40%

Source: Author, 2018

As demonstrated in Appendix E-4, 72.4% of cases used to create the ANN model were classified correctly and 77.1% of cases used in the training model were classified correctly, corresponding to 27.6% incorrect predictions as shown in the model summary. When controlling for the developers who do not alter or adjust their hurdle rates, the model accuracy improves to 88.2% correct predictions which can be considered a good model.

Finding RQ 5

The majority of respondent developers (61%) do not have a pre-determined process and method of altering or adapting the chosen hurdle rates and benchmarks, even in the presence of an expected change in uncertainty and risk to a potential project. Of the 39% of survey respondents who do alter their hurdle rates, the primary basis for that change can be considered under three themes which are altering hurdle rates on the basis of risk analysis and forecasted market conditions, altering hurdle rates based on qualitative frameworks or intuition, and altering hurdle rates based on the project's status of planning approvals or along the lines of altering hurdle rates for specific geographic regions. The most important variables in predicting whether survey respondents alter their hurdle rates included the developer typology, type of property developed, education level and whether the decision-maker uses MDC or IRR as a hurdle rate.

6.3.8 Determination of research question RQ 6:

RQ 6: Do development companies demonstrate bounded rationality in their decision-making processes?

The analysis of the data collected in the survey demonstrates that developers rely heavily upon intuition and individual experience rather than upon more sophisticated quantitative and qualitative methods to make decisions on whether to proceed with a project. Additionally, the quantitative analysis methods incorporated are predicated upon the decision-maker determining an appropriate hurdle rate for project selection. The results demonstrate bounded rationality in that the majority of respondents do not alter these hurdle rates in light of a change in the perceived risk and/or uncertainty for a project and/or specific property market. Both the hurdle rates chosen and the minimum acceptable financial metrics are broadly in line with those traditionally required by financial capital providers and have changed little over time or across different geographic regions. This very high adoption of a specific minimum financial metric demonstrates the predominant use of a normative approach and a large level of acceptance of the industry rule of thumb. It should also be noted that the standard deviation of the most commonly used hurdle rates of MDC & IRR were found to be in an extremely tight grouping as discussed in section 6.3.3. These results are also in line with what Crosby *et al*. (2018) found in European property developers

It should also be noted that these common rules of thumb regarding feasibility analysis have served the industry well in the past in that respondents believe that these levels allow for a sufficient level of profit to be required to warrant taking on the risks that are typically associated with property development projects. Small differences do exist across development projects in relation to property type categories as well as across the property developer typologies. However, there is a propensity within the property development industry to apply a single hurdle rate metric across in the same method and manner for all projects.

Finding RQ 6:

The property development organisations surveyed demonstrated a heavy reliance on industry-accepted rules of thumb for selecting and setting the specific level of hurdle rate metrics when deciding whether to proceed with a development project beyond the pre-commitment stages of the development process. Additionally, the selection and usage of specific hurdle rates did not change given a perceived change in the risk and uncertainty of a project. The rationale for the choosing and setting of minimum hurdle rate metrics is based largely on experience, intuition and the minimum accepted benchmarks set by providers of capital finance to the property development industry. Residential developers and the typology of Trader Developers were more likely to rely on a narrow range of MDC (median 20% and standard deviation of 1.41%) and IRR (median 18% and standard deviation 4.85%) percentages.

6.3.9 Contribution of respondent organisations decision processes & hurdle rate selection

Section 6.3 provided an explanation and interpretation of the decision process of property development organisations when deciding to proceed with a potential project beyond the pre-commitment stages of the development process. Respondent selection and use of hurdle rates, project approval processes and the adjustment of decision-making mechanisms were described. Hurdle rate selection and use was also investigated across a number of respondent developer characteristics including property developer typologies, property types, size and motive of the development organisations, respondent education levels, experience and qualifications. The following section outlines the analysis which was completed regarding the practices and methods used by respondent developers in undertaking feasibility analysis and determining the value of potential sites for acquisition.

6.4 Feasibility practices (dependent variables)

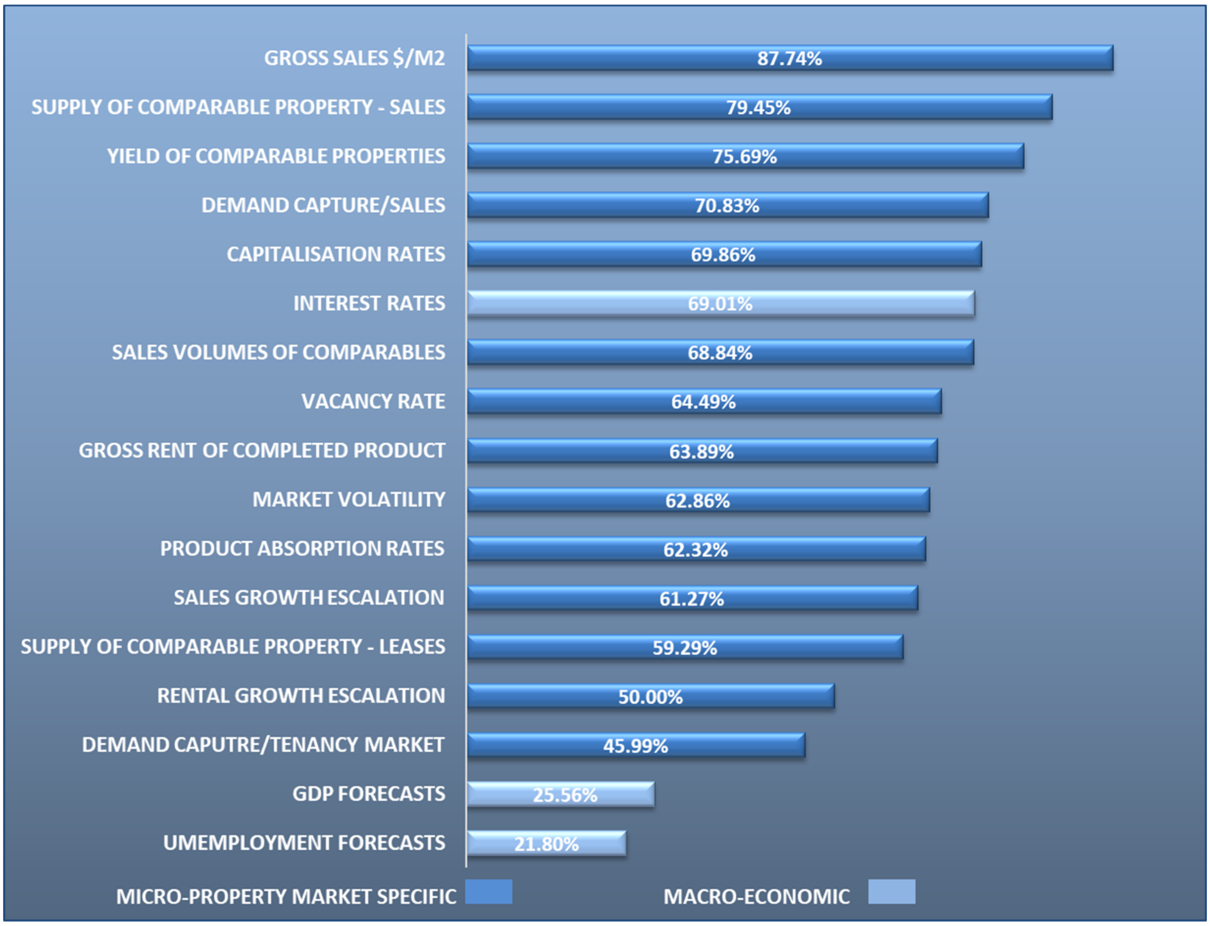
This section will outline the frameworks of the feasibility analysis practices of respondent property development firms and decision-makers. Additionally, an examination of forecasted variables, methods of determining viability and aspects of the practical execution of viability studies is discussed.

6.4.1 Variables that respondent organisations forecast in order to complete a feasibility analysis

The variables used as inputs in conducting feasibility analysis are highly important in understanding the outcome regarding the viability of a project. Figure 6.4.1 displays information concerning key variables (including frequency of use) that respondents indicated their organisation commonly utilise in determining a go/no-go decision for a potential property development project. In relation to the context of the pre-commitment stages of the property development process, Figure 6.4.1 ranks the frequency of use of forecasted variables of respondent organisations in the decision-making process. An analysis of variables that are 'always' or 'very often' forecasted demonstrates the priority of the projection of project revenue followed by variables for comparable properties and rental yields which are 'often used' as a basis for determining project value on completion. It should be noted that the forecasting of variables as inputs into feasibility analysis is not an exact science and is prone to error.

Variables including gross sales in dollar per square metre (87.74%, n = 155), supply of comparable property (sales value) (79.45%), yield of comparable properties (75.69%), the percentage market capture of sales (demand) (70.83%), capitalisation rates (69.86%) and interest rates (69.01%) are the most frequent variables forecasted. These variables are followed by other indicators concerning rental and sales characteristics within the micro-property market within which the potential project is competing. Additionally, the frequency of usage of variables indicates information that is either from the past, such as comparable sales or leasing data, or variables that give a reflection of the current state of the market.

Figure 6.4.1: Forecasting variables used in feasibility analysis listed by frequency of use (multiple responses possible)



Source: Author, 2018

As discussed in Chapter 2, property development projects often occur over a timeframe of two to ten years and the analyst is forced to decide whether to proceed with a potential project which may enter the market several years in the future. Also, longer-term measures such as rental escalation and sales growth escalation were less frequently used. It is also significant to note that macroeconomic indicators are rarely forecasted with the exception of interest rates. This result is similar to the study conducted by Wiegelmann (2012), where European property developers indicated the use of short-term demand and supply information most frequently. The results indicated the use of DCF and capital budgeting measures as a primary means of decision making.

6.4.2 Use of proprietary feasibility analysis software programs

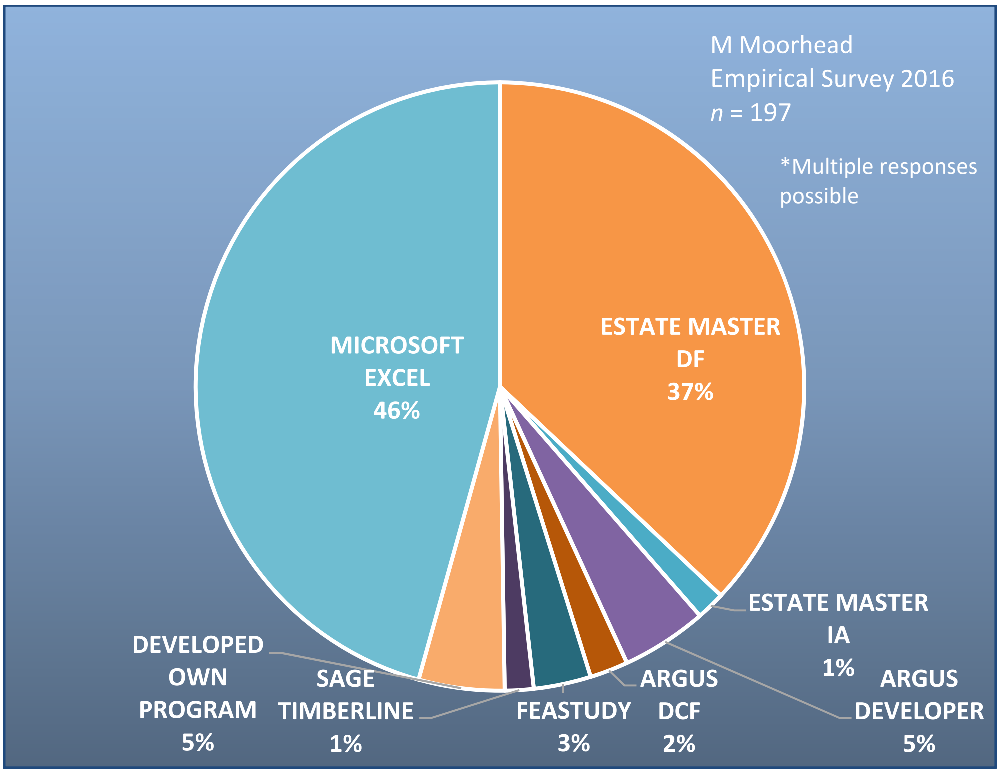
Does your company use a proprietary development feasibility program for decision-making in choosing whether to proceed with property development projects?

An objective within this research was to ascertain the practice and frequency of use of proprietary feasibility analysis software programs that are commonly used within the industry. Participants were asked to provide details of their use of proprietary property development feasibility programs to aid in the decision-making process in the organisation where they are employed. 53% (n = 188) of respondents indicate they use proprietary feasibility analysis software and 47% indicated that their organisation did not. It is generally accepted within the property development industry that a feasibility study is conducted with the aid of Microsoft Excel, proprietary feasibility analysis software or, on the rare occasion as a manual calculation. Participants who indicated they do not use proprietary feasibility analysis programs were then directed to the following question:

If you answered No in the question above, please specify how feasibility analysis is completed. (Example, Microsoft Excel)

The responses to this question were open-ended to allow respondents to give greater detail of how they practically complete a feasibility analysis. The responses were then coded into the three categories including Microsoft Excel, their organisation having developed a custom model, or the reliance on outside consultants to complete a feasibility analysis for their organisation. The frequency of responses are included in Table 6.4.2 below. Participants that indicated that they utilise proprietary feasibility analysis software programs were then directed to indicate which programs they use, and the possible answers included the following:

Figure 6.4.2: Types of feasibility analysis programs used



Source: Author, 2018

Please specify which proprietary development feasibility program/s are used for decision-making in whether to proceed with property development projects?

The results of these questions are displayed in Table 6.4.2 and Figure 6.4.2 and demonstrate that Microsoft Excel is the most commonly used software for the completion of feasibility analysis with 48% of responses, followed by Estate

Master DF (development feasibility) with 39% of responses and 4% of respondents using both.

Table 6.4.2: Feasibility analysis program utilisation

	Responses	% Responses
Microsoft Excel	90	46%
Estate Master DF	73	37%
Argus Developer	9	5%
Developed Own Program	9	5%
Feastudy	6	3%
Argus DCF	4	2%
Estate Master IA	3	2%
Sage Timberline	3	2%
Total	197	

*more than one response is possible

Source: Author, 2018

6.4.3 Determination of research question RQ 3:

RQ 3: Do organisations and decision-makers that utilise proprietary feasibility programs differ in their feasibility practices and selection and use of hurdle rates from those which use Microsoft Excel or create their own feasibility program?

The feasibility practices of survey respondents were analysed to test if there is a significant difference between those who use proprietary feasibility programs from the respondents who use Microsoft Excel, have their own bespoke program or use another method of conducting a feasibility analysis. A number of statistical tests were conducted including independent-sample t-tests, Chi-Square tests of independence and Mann-Whitney U tests of independence.

A series of independent-sample t-tests were conducted to compare the mean score of respondents who use or do not use proprietary feasibility software for the number of specific hurdle rates used, the specific percentage of MDC, IRR and ROE adopted, the number of variables forecasted, the number of levels of approval required to proceed with a project and the years of experience of survey respondents (See Appendix G-1). A significant difference was found at the at the $p < .05$ level in in the mean number of specific hurdle rates used in decision-making at the pre-commitment stages of the development process for those who use proprietary feasibility analysis software ($M = 1.78$, $SD = 1.41$) and those who do not ($M = 1.22$, $SD = 1.35$; $t\ (186) = -2.789$, $p = .006$, two-tailed). Proprietary feasibility software usually will have a number of key industry-accepted hurdle rate metrics that are automatically calculated. This result is not surprising as decision-makers would have these metrics readily available and would not need to specifically calculate the result. Also, it was found that there was a statistically significant difference, at the at the $p < .05$ level, in the mean level of the specific IRR percentage adopted between those who use proprietary feasibility software ($M = 19.22$, $SD = 4.96$) as higher than those who do not ($M = 16.80$, $SD = 4.32$; $t\ (64) = -2.065$, $p = .043$, two-tailed). The other variables that were tested include the specific percentage of MDC and ROE adopted as a minimum financial metric, the number of input variables used in forecasting a potential project's cash flow, the number of approval levels within the organisation required to proceed and the mean years of experience of decision-makers; these variables were not found to be significant. The results of the analysis can be found in Appendix G-1 and is illustrated in Figure 6.4.3a.

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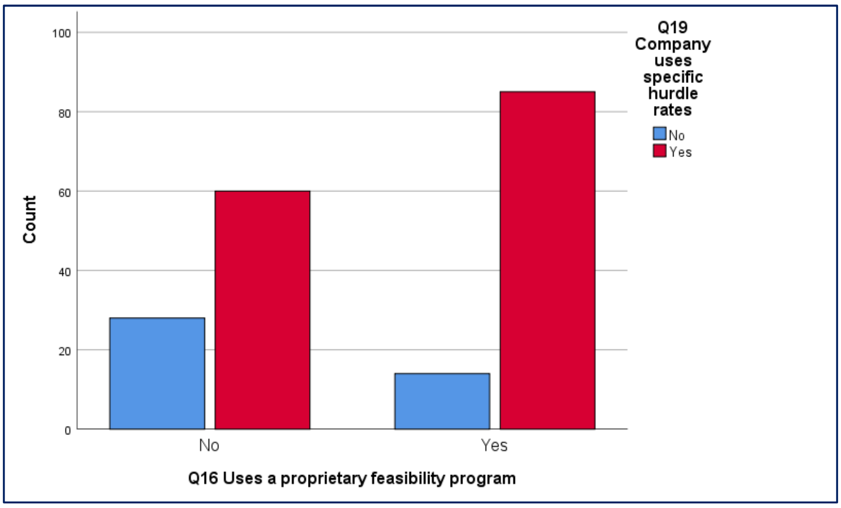
Figure 6.4.3a: Chi-Square test of independence showing association between the use of a proprietary feasibility program and the use of specific hurdle rate metrics

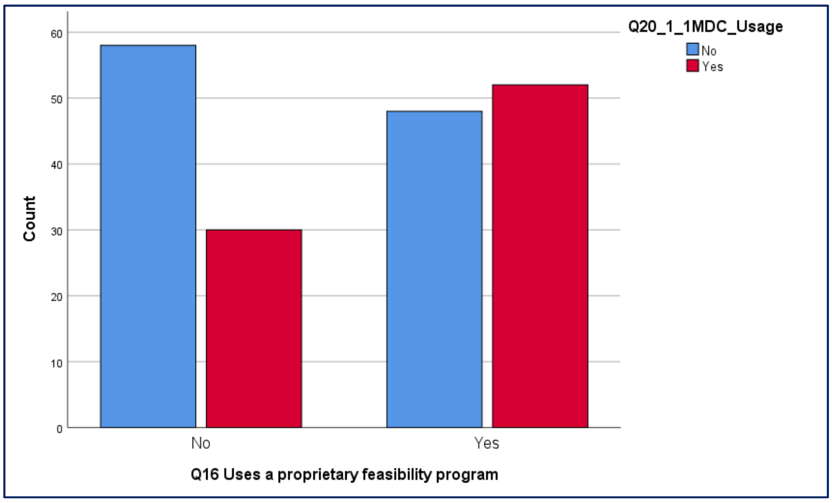


Source: Author, 2018

A number of Chi-Square tests of independence were conducted to assess the association between the use of proprietary feasibility programs and the use of specific hurdle rate metrics including MDC, IRR and ROE. An association between the use of a proprietary feasibility program and Q19 regarding the use of specific hurdle rates as part of a decision-making process was demonstrated at the 95% statistical significance level, χ^2 (1, n=187) = 8.359, p<.004; (see Appendix H-12) and is illustrated in Figure 6.4.3a. Additionally, an association with the use of MDC as a hurdle rate was demonstrated, χ^2 (1, n=188) = 6.105, p<.013) which is illustrated in Figure 6.4.3b.

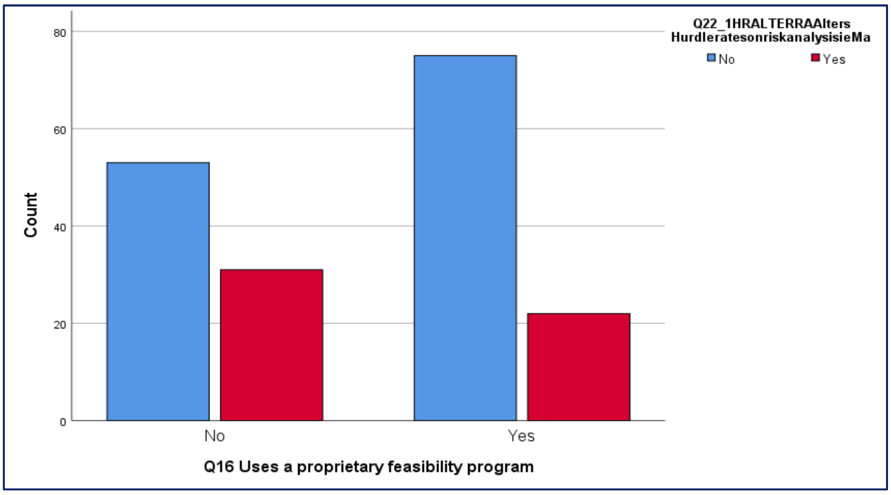
Figure 6.4.3c illustrates an additional association at the 95% statistically significance level that was demonstrated by a Chi-Square test of independence between those who use a proprietary feasibility program and adapting or altering hurdle rates based on a change in uncertainty or risk, χ^2 (1, n=181) = 4.39, p<.036; (see Appendix H-13). This result is interesting, as the advent of proprietary feasibility analysis software has led to the process of completing a feasibility analysis for a potential project easier and less time consuming to adapt and alter hurdle rates than in Microsoft Excel (Havard, 2014, p. 79 & p. 107). This factor may influence the frequency of hurdle rate adaption as a response to a change in the perceived uncertainty and risk in a project and would be worth researching further.

Figure 6.4.3b: Chi-Square test of independence showing an association between the use of a proprietary feasibility program and the use of MDC as a hurdle rate



Source: Author, 2018

Figure 6.4.3c: Chi-Square test of independence showing an association between the use of a proprietary feasibility program and altering or adapting hurdle rates based on a change in uncertainty or risk



Source: Author, 2018

The use of bespoke feasibility programs

In order to assess differences between respondent developers regarding the use of bespoke feasibility programs, a series of Mann-Whitney U tests were conducted to look at predictors of development companies that developed and use specific bespoke feasibility development software (See Appendix F-8). The development of bespoke feasibility software is a time consuming and expensive exercise and, because of this, it was expected that larger and more experienced firms would engage in this activity. A number of significant results were found in a cross-sectional analysis which is summarised in Table 6.4.3. The results demonstrate that development organisations which have developed a bespoke feasibility analysis program are more likely to be publicly listed, have larger project sizes (> $50 million), undertake projects in the tourism sector, use IRR as a hurdle rate, have more years of decision-making experience, use a DCF methodology for feasibility analysis, have specific go/no-go hurdle rates, have specific mechanisms for adjusting hurdles rates, adjust hurdle rates on perceived risk and adjust hurdle rates on the level of planning application needed. These organisations are also less likely to be privately structured or to be trader developers.

Finding RQ 3:

There were a number of differences found among survey respondents who use a proprietary feasibility analysis program. First, a key difference included being more likely to use specific hurdle rate metrics to make a decision to proceed with a project beyond the pre-commitment stages of the development process. Second, they were more likely to use a specific hurdle rate metric in determining project viability and were also more likely to alter or adapt hurdle rates given a change in project outcome uncertainty or risk. Third, they were more likely to use MDC as a hurdle rate metric, but there was no difference in the percentage level adopted. Fourth, survey respondents who use proprietary feasibility programs use a higher percentage of IRR as a hurdle rate but are no more likely to use ROE or MOR. Fifth, the number of variables used in forecasting, the number of approval levels required to proceed and the mean years of experience of decision-makers were not found to be significant. Finally, in terms of the use by developers who use bespoke property development programs and those who do not, differences were found based on the preferred project size and whether the organisation is publicly listed or not.

6.4.4 Retrospective Analysis of Forecasts

Have the variables forecasted in feasibility analysis remained constant over the past five to seven years?

Respondents were asked if they have changed the variables forecasted for feasibility analysis over the past five to seven years or if they have remained constant. The rationale for asking this question was to determine the level of change that has been brought about in feasibility analysis and viability appraisal practices post the GFC. The time of this survey (2016) puts boundaries around the industry emerging from the effects of the GFC. The results of the responses to this question are shown in Table 6.4.4a.

Table 6.4.4a: Change in variables forecasted in feasibility analysis

	Responses	% Responses
Almost Always	51	30%
Sometimes	108	64%
Occasionally	0	0%
Never	10	6%
Total	169	100%

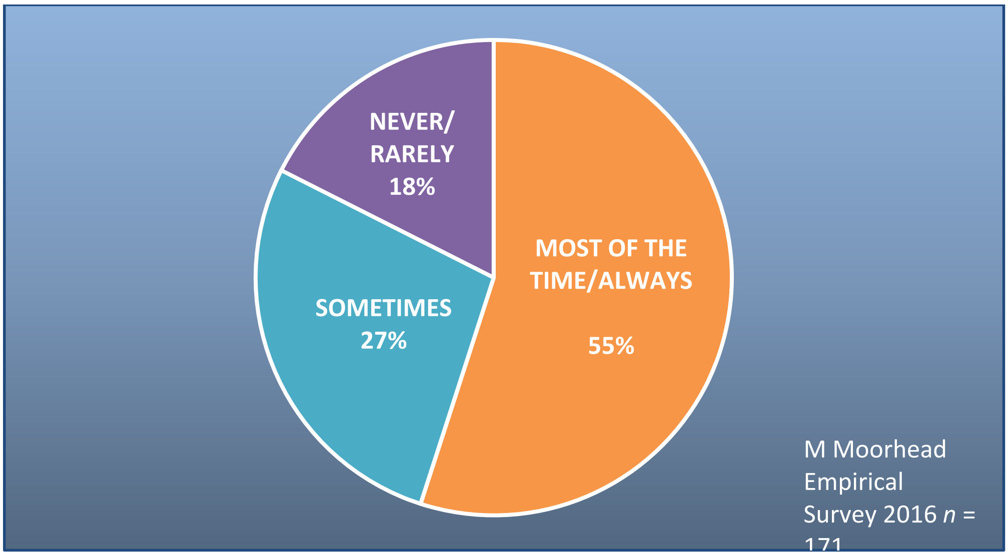
Source: Author, 2018

The results show there has been a modest amount of change post-GFC in the variables forecasted. Respondents were also asked if they retrospectively check the forecasts of their feasibility analysis and the results are illustrated in Table 6.4.4b.

Do you retrospectively check your forecasts?

Figure 6.4.4 presents the results of the question regarding respondents retrospectively checking their forecasts post project completion, which is considered an important step in improving an organisations practices in determining project viability. The results demonstrate that the majority of respondents (55%) retrospectively check their forecasts in their analysis. The retrospective checking of forecasted variables within a feasibility analysis is an important process for decision-makers to learn from their past forecasting activities by understanding which variables they tend to find most difficult to forecast, and therefore gain insights into which variables have the highest degree of uncertainty.

Figure 6.4.4 Retrospective analysis of forecasts



Source: Author, 2018

Table 6.4.4b: Mann-Whitney U test of independent samples for developing a bespoke feasibility analysis program (See Appendix F-8)

Variable Tested	Mann-Whintey U Score	*Z* - Score	*p* - vlaue	Median Value	Vs Median of Null	*n* =	*r* =	Result	Sig %
Private company structure	398.00	-3.105	0.002	0.11	0.63	9	0.224	Less likely to use	95%
Large project developer size	447.00	-1.978	0.048	0.88	0.52	8	0.147	More likely to use	95%
Trader Developer	648.00	-2.096	0.036	0.00	0.33	9	0.143	Less likely to use	95%
Tourist Developer	787.50	-2.841	0.004	0.22	0.03	9	0.189	More likely to use	95%
Publicly listed	306.50	-3.995	0.000	0.89	0.27	9	0.290	More likely to use	95%
Use of IRR hurdle rate	565.50	-2.351	0.019	0.67	0.30	9	0.163	More likely to use	95%
Alters HR on planning/geo basis	473.50	-2.229	0.026	0.29	0.06	7	0.166	More likely to use	95%
Uses DCF methodology	373.00	-1.968	0.049	0.56	0.48	7	0.147	More likely to use	95%
Years of experience	530.00	-1.788	0.074	3.38	2.52	9	0.130	Use increases w/ years	90%
Use specific go/no-go decision	567.00	-1.921	0.055	1.00	0.70	9	0.136	More likely to use	94.5%
Has mechanism for HR altering	405.00	-1.775	0.076	0.71	0.38	7	0.132	More likely to use	90%
Alters hurdle rate based on risk	432.50	-1.648	0.099	0.57	0.28	7	0.122	More likely to use	90%

Source: Author, 2018

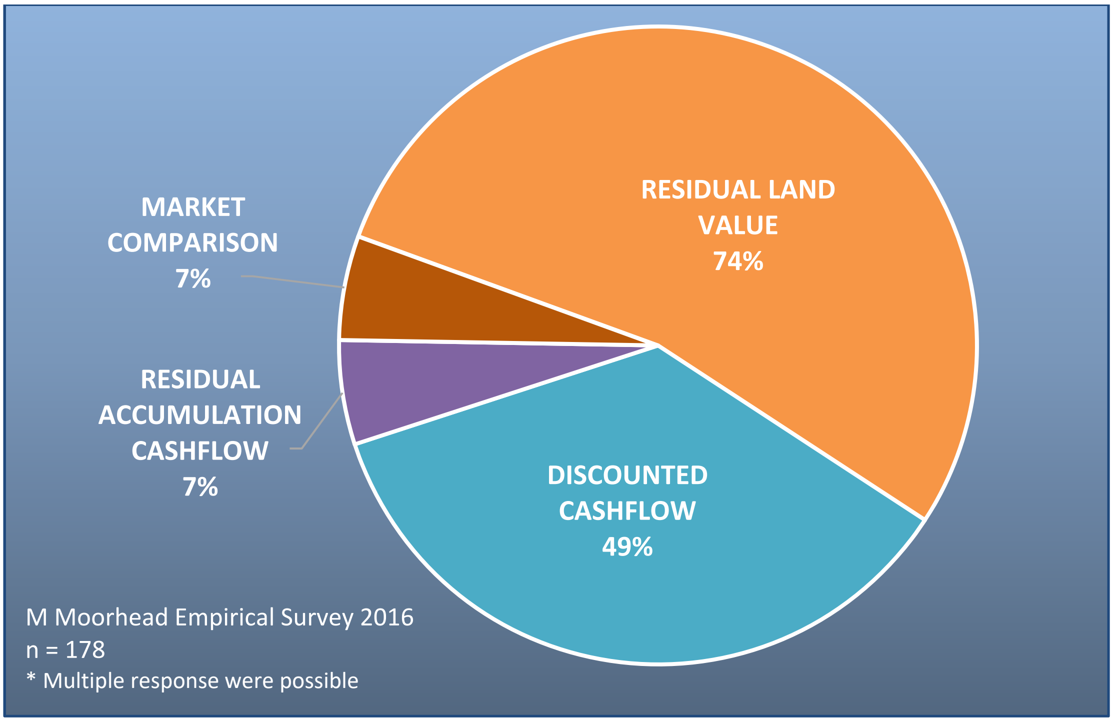
6.4.5 Determination of research question RQ 4:

RQ 4: Do Australian and New Zealand development companies use the residual land value method, the discounted cash-flow method, the residual accumulation cash flow method and/or the market comparison method for determining a potential development site's value in the pre-commitment stages of the property development process?

Survey respondents were asked to specify which of four commonly used land valuation methods, as discussed in Chapter 3, were used in their feasibility analysis decision-making. Figure 6.4.5 illustrates the percentage usage of each of the four methods. The most commonly used method was the residual land value method with 74% usage. The other method that had a high level of usage was the discounted cash flow method with 49% usage, and the remaining two methods, being the residual cashflow accumulation method (RACFM as discussed in section 3.3.4) and the market comparison method, had a surprisingly low level of usage at 7% each, and it should also be noted that respondents were able to choose more than one response. The result is surprising as the market comparison method is commonly used by property valuers in assessing site value and the residual method accumulation yields a result that is helpful to property developers in assessing future cash flow needs for each period of the cashflow. It should also be noted that multiple responses were possible for this question.

A Mann-Whitney U test was conducted to test if significant differences exist in the use of land valuation techniques based on the decision-makers' experience. The test revealed a statistically significant difference (95% confidence level) exists in the use of the residual land value methods by survey respondents with more experience (Md = 3.00, n = 132) than respondents who do not use this method (Md = 2.00, n = 64, U = 2224, z = -2.599, p = .009). The discounted cash flow method, residual cash flow accumulation method and the market comparison methods of site valuation did not show significant results (See Appendix F-14).

Figure 6.4.5: Percentage usage of methods of land valuation in feasibility analysis



Source: Author, 2018

Finding RQ 4:

Respondent developers primarily use the residual land value method and the discounted cash flow method to value a site in the pre-commitment stages of the development process. The residual cash flow accumulation method and the market comparison method are not used widely by respondents for this purpose. Additionally, respondent developers with more than ten years' experience are more likely to use the residual land value method than lesser experienced respondents. Experience did not play a significant factor in whether the users used the discounted cash flow method, the residual cash flow accumulation method or the market comparison method, and multiple responses were possible.

6.4.6 Contribution of respondents regarding the feasibility analysis practices of property developers

This section covers the practices of survey respondent organisations in determining project viability in the pre-commitment stages of the development process. The use of proprietary feasibility analysis software programs, use of bespoke feasibility analysis programs, variables forecasted and the retrospective review of forecasts is discussed.

6.5 Risk analysis and cultural environment (dependent variables)

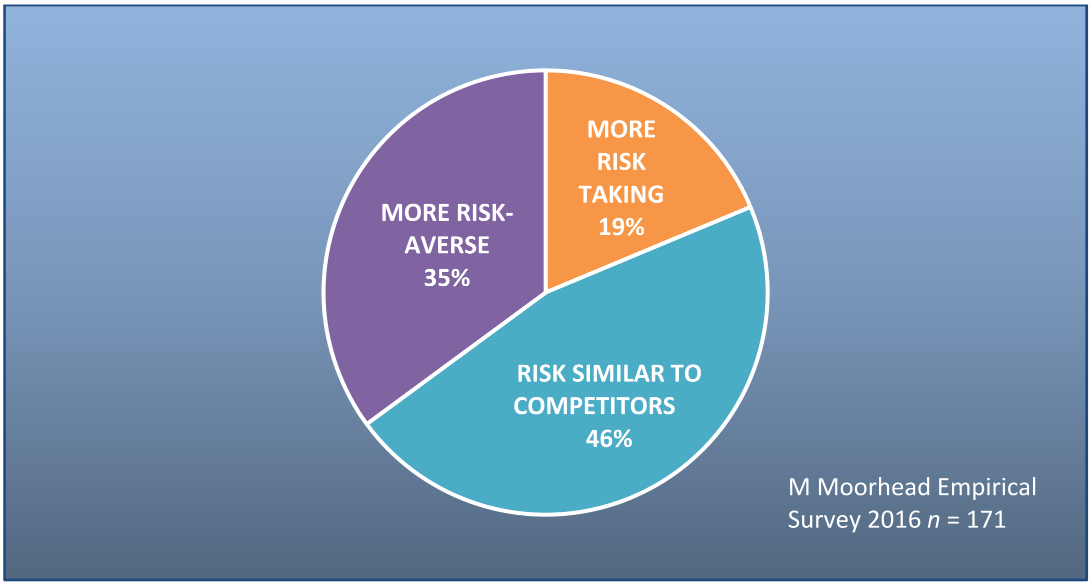
The purpose of this section is to examine the risk analysis and management practices of respondent property developers and gain an understanding of the cultural aspects of the organisation regarding their risk tolerance and confidence. Respondents were asked questions to gauge their perception of risk appetite, confidence in preparing for significant risks and about their employer's risk management policies and culture. Additionally, respondents were asked about the use of specific risk analysis methods used in feasibility analysis to determine whether to proceed with a project.

6.5.1 Risk appetite perception

In your opinion, does the company you work for regard itself as having a risk-taking or risk-averse culture compared to its relevant competitors?

Participants were asked to rate their perception of the risk appetite of their organisation against their competitors by indicating either more risk-averse culture, having a risk-taking culture similar to competitors or more risk-taking culture. Figures 6.5.1 summarise the results where 35% of respondents who specified the organisation they work for as more risk-averse, 46% believe the risk culture is similar to competitors and 19% specified the culture is more risk-taking. This question was patterned on a question in Wiegelmann (2012, p. 112), who surveyed European property developers, and the results are compared in Table 6.5.1a.

Figure 6.5.1: Perception of organisational risk appetite



Source: Author, 2018

The main point of comparison between the two surveys is the similarity of the frequency of perceived risk appetite across property development organisations between Europe and Australia/New Zealand in terms of both separate geographic areas and also across different time horizons. Wiegelmann (2012) found private company structured organisations in Europe were the most risk tolerant and publicly listed organisations had the highest levels of perceived risk aversion, but a different result was found in this research when an independent samples t-test was conducted finding no significant difference between private structures (M = -0.11, SD = 0.721) and public structures (M = -0.12, SD = 0.689; t = (158) = -0.09, p = .928, two-tailed; See Appendix G-3). This result is surprising as it had been anticipated that private company structures, which most small development firms would use, would be significantly more risk-tolerant, but the survey responses included many development organisations which undertake medium and large projects and also use a private structure.

Table 6.5.1a: Responses of perception of organisational risk appetite: Wiegelmann (2012) and Moorhead (2016) compared

Organisational Risk Appetite	Wiegelmann (2012)	Moorhead (2016)
More risk taking	14.50%	18.71%
Risk similar to competitors	55.10%	46.20%
More risk-averse	30.40%	35.09%
Total	100.00%	100.00%

Source: Author, 2018

However, when a one-way ANOVA between groups was conducted to explore the impact of project size on risk perception, statistically significant differences were found and the results are presented in Table 6.5.1b and Table 6.5.1c. There was a statistically significant difference at the p < .05 level in the mean risk tolerance perception score based on project size. Prior studies have found that small development organisations take on more risk early in order to grow and achieve greater economies of scale (Whitehead, 1987). The organisations generally grow larger if successful and undertake increasingly large project sizes or fail along the way. This analysis found that respondent developers who undertake small project sizes had a higher mean risk tolerance perception than either medium or large project sizes, but interestingly those who undertake medium sized projects had a significantly more risk averse score (See Appendix J-8). The reason for this is unclear and should be researched further in the future.

Table 6.5.1b: One-way ANOVA of project size and risk tolerance perception score

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.273	2	2.136	4.352	0.014
Within Groups	79.521	162	0.491		
Total	83.794	164			

Source: Author, 2018

Table 6.5.1c: Mean, standard deviation and standard error of large medium and small project sizes and risk tolerance perception

	N	Mean	Std. Deviation	Std. Error
Small	25	0.08	0.759	0.152
Medium	57	-0.35	0.668	0.088
Large	83	-0.06	0.705	0.077
Total	165	-0.14	0.715	0.056

Source: Author, 2018

6.5.1.1 Difference in risk appetite perception between developer types

The respondents' risk appetite perception score was also examined in relation to developer type to investigate if significant differences exist between groups. Table 6.5.1d summarises the cases and grouped median of each developer type's risk score where 1 indicates more risk-taking, 0 indicates risk similar to competitors and -1 indicates more risk-averse.

The respondents' risk appetite perception of the organisation they work for was examined in relation to developer type to investigate if significant differences exist between groups. A comparison was made between trader developers and the other developer types in comparison to risk appetite perception. A Mann-Whitney U Test revealed a statistically significant difference (95% confidence level) exists in the level of risk appetite perception of Trader (*Md* = 0.00, *n* = 64) and other developer types (*Md* = -0.30, *n* = 107), *U* = 2780, z = -2.227, *p* = .026, *r* = 0.17 with a medium effect size; See Appendix F-13). Trader developers specified a median risk appetite score that is risk-neutral in comparison to their competitors. All other developer types demonstrated a more risk-averse perception of their organisation (score less than 0) in comparison to that of their competitors. This result is not surprising as trader developers fulfil the more speculative aspects of the property development industry which carries a greater level of risk than do the other developer typologies which would be less comfortable with assuming higher levels of project risk.

Table 6.5.1d: Grouped median of developer type risk appetite perception

Developer Type	N	Median	Grouped Median
Other	10	-1.00	-0.70
Trader Dev	64	0.00	0.00
Investor Dev	29	0.00	-0.18
Development Management	44	0.00	-0.27
Valuation	17	0.00	-0.29
Funds Management	6	0.00	-0.20
Total	170	0.00	-0.20

Source: Author, 2018

6.5.2 Project risk analysis methods

Does your company utilise any of the following risk analysis methods for determining the project viability of potential development projects in the pre-commitment stages of the development process?

- Sensitivity Analysis of single variables

- Scenario Analysis of multiple variables
- Probability Analysis/Bayesian Models
- Monte Carlo Simulations
- Real Option Models
- Qualitative Risk Matrix
- Other (please specify)

Risk analysis is an important step in the process of determining a potential project's viability. Many theoretical examples and techniques exist in the literature for the examination and analysis of project risk which are summarised in Table 6.5.2.

Table 6.5.2: Methods for analysing project risk

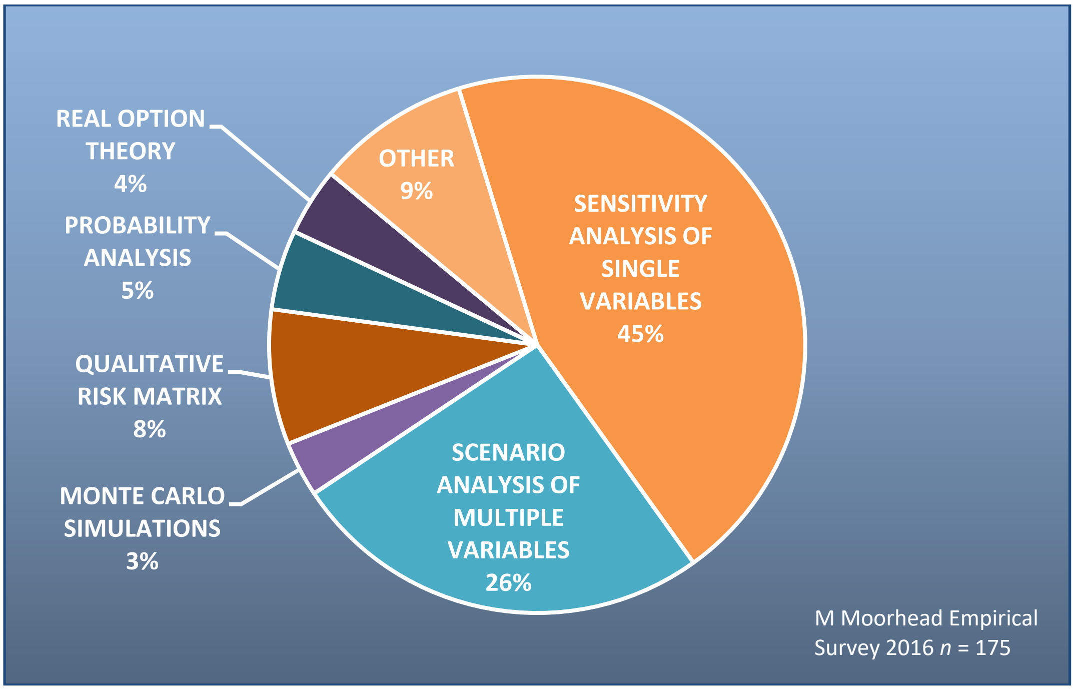
Deterministic methods	Qualitative methods	Quantitative methods
Benefit cost analysis	Risk matrix	Mean-variance criterion
Break-even analysis	Event trees (qualitative)	Decision tree analysis
Certainty equivalence	SWOT analysis	Artificial intelligence
Sensitivity Analysis	Risk scoring	Fuzzy sets theory
Discounted cash flow	Brainstorming sessions	Event trees (quantitative)
Standard deviation and variance	Likelihood/consequence assessment	Monte Carlo Stochastic simulation
Risk-weighted DCF discount rates	Risk registers and coefficients of variation	Input estimates based on probability distribution

Source: Author- derived from Boussabaine & Kirkham (2004); Regan (2015)

Respondents were asked whether they utilise specific risk analysis methods, commonly found in proprietary feasibility analysis programs, in their decision-making processes before deciding whether to proceed with a project beyond the pre-commitment stages of the development process. Additionally, respondents were given an opportunity to list and describe any additional risk analysis methods used by their development organisation. Figure 6.5.2 illustrates the frequency distribution results of respondents concerning the use of common risk analysis methods used in the industry which were discussed in Chapter 4. The use of a sensitivity analysis of a single variable was widely used with 45% of respondents indicating the use of this method. This method is simple to incorporate into a feasibility analysis and has been used within the industry for many decades. The use of a scenario analysis of multiple variables had the second-highest adoption by respondents at 26%. Eight per cent of respondents indicated they use qualitative frameworks including the use of a risk matrix in their risk analysis process.

Within Microsoft Excel, this technique becomes more complex to complete than the calculation of a single variable sensitivity analysis. Scenario analysis of multiple variables has become a common feature of proprietary feasibility analysis software. In fact, when a Mann Whitney U test was completed comparing the median score of respondents who use Microsoft Excel for feasibility analysis and the risk analysis methods listed in the survey instrument, it was found that only the use of sensitivity analysis of a single variable was statistically significant with 55% of respondents who use Microsoft Excel indicating using this method ($Md = 0.55$, $n = 179$, $U = 2960$, $z = -3.719$, $p = .000$, $r = 0.28$; See Appendix F-9). Usage of all other risk analysis methods was negligible by respondents who use Microsoft Excel. This result casts doubt upon whether property developers are able to fully analyse and manage risks at this stage of the development process when using Microsoft Excel as their primary feasibility analysis tool. The doubt arises from the lack of sophisticated risk analysis techniques being used by respondent developers who use Microsoft Excel for the purpose of feasibility analysis. Additionally, this result is becoming increasingly important as the rate of development of quantitative risk analysis methods within proprietary feasibility analysis programs has made these tools highly accessible.

Figure 6.5.2: Risk analysis methods used in feasibility analysis at the pre-commitment stages of the property development process



Source: Author, 2018

Other quantitative techniques that were included in the list of possible answers demonstrated a low level of adoption by the property development industry. The results of these indicators included probability analysis at 5% adoption, Real option theory at 4% adoption and Monte Carlo simulations at 3% adoption. This result highlights a substantial disparity between the theory in the literature and industry practice. There has been extensive research, in the area of finance and decision-making, dedicated to the development and testing of these methods, some of which were described in Chapter 4. Other surveys have reported a similarly low level of adoption of more quantitatively sophisticated methods. Newell and Steglick (2006) found a 25% adoption of risk simulations and 37.5%

adoption of probability models in a survey of 24 large ASX listed property development companies. It is commonly accepted that larger publicly listed property development companies would use more sophisticated highly quantified models because of their access to higher levels of resources including staff. The use of specific risk analysis methods was investigated concerning respondents' indication of a consistently applied decision-making methodology in the company where they work, but no significant difference was found to exist. The results of this analysis can be found in Appendix F-11.

6.5.3 Determination of research question RQ 7:

> ***RQ 7: Do Australian and New Zealand property development companies use sophisticated theory led structured quantitative analysis in the feasibility analysis models used in the decision-making processes in the pre-commitment stages of the development process? Do Australian and New Zealand development firms use Monte Carlo simulations, Bayesian models, and/or option theory to aid decision-making?***

Hutchinson *et al*. (2017, p10) defined sophistication in the use of hurdle rates and risk analysis in property investment decision-making as follows:

> *…The use of formal, theory-led, quantitative models, use of structured scenario or sensitivity analysis, strong research or risk department involvement in model inputs and, generally, more complex processes.*

The survey results indicated a very low level of adoption and use of the more sophisticated quantitative techniques including Monte Carlo Simulation, probability analysis, qualitative risk matrix, option theory all having less than 5% usage by decision-makers in the pre-commitment stages of the development process. Hutchinson *et al*. (2017, p.10) also found very low levels of use of sophisticated decision-making models of property investors and developers in the UK an offered a number of reasons as an explanation including the perceived difficulty in applying models to heterogeneous assets, senior management reluctance to accept new approaches, and gaps in the knowledge and human capital to incorporate sophisticated modelling techniques. These explanations may also be relevant to the Australian and New Zealand property development industry and is an area which will be considered for further research.

Table 6.5.3a: Mann-Whitney U test between groups of respondents who use Monte Carlo, Real option theory or Probability analysis/Bayesian models and variables

	Uses MC, ROT or Prob B					
Variable Tested	yes	no	*U*	*p-value*	Result	Sig %
Experience (years > 5)	35	140	2196	0.327	No association	95%
Publicly Listed	35	138	2095	0.115	No association	95%
Education Level	35	140	2110	0.172	No association	95%
Property Qualification	34	135	2281	0.933	No association	95%

Source: Author, 2018

Notwithstanding the low levels of use of the above risk analysis methods indicated by survey respondents, a number of Mann-Whitney U tests were conducted to determine if there was a statistically significant higher level of use in terms of experience, publicly listed development company and educational levels. No statistically significant difference was found between groups of these indicators, the results of which are presented in Table 6.5.3a and also in Appendix F-1.

A series of t-tests of independence were conducted to determine if there was a statistically significant difference between groups of those who use and do not use Monte Carlo simulations, real option theory and probability/Bayesian models. The use of these risk analysis techniques was condensed into a single variable called Complex Quantitative Risk Analysis and the results of the tests are presented in Table 6.5.3b and also can be found in Appendix G-6.

Table 6.5.3b: T-test of independence of use of complex quantitative risk analysis methods and dependent variables

Independent Samples Test							
		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	*t*	*df*	*p = value*	
Experience years	Equal variances	0.01	0.94	0.96	173.00	0.34	
	Equal variances			0.96	52.31	0.34	
Number of approval levels	Equal variances	26.39	0.00	-2.82	144.00	0.01	
	Equal variances			-1.94	33.89	0.06	
Dominant Development size	Equal variances	0.27	0.60	-1.67	167.00	0.10	
	Equal variances			-1.68	53.80	0.10	
Number of specific hurdle rates	Equal variances	2.29	0.13	-0.40	173.00	0.69	
	Equal variances			-0.37	47.42	0.72	
Number of risk analysis	Equal variances	13.75	0.00	-6.91	173.00	0.00	
	Equal variances			-4.62	37.93	0.00	
Risk Tolerance Perception	Equal variances	0.33	0.57	-0.42	169.00	0.68	
	Equal variances			-0.40	47.73	0.69	

Source: Author, 2018

The results of the t-tests of independence found a statistically significant result (95% confidence) between groups of those who do and do not use complex quantitative risk analysis methods and the number of approval levels for decision-making, the number of risk analysis methods used. Additionally, a 90% confidence significance was found with dominant development project size.

This results indicates that larger development companies with more layers of approval and who use more risk analysis methods in their project acquisition tend to use more sophisticated complex quantitative analysis methods.

Finding RQ 7:

The analysis of the survey results found a very low level of adoption and use of the more sophisticated quantitative techniques including Monte Carlo simulation, probability analysis, qualitative risk matrix and Real option theory, with all having less than 5% usage by decision-makers in the pre-commitment stages of the development process. Of those respondents who do use these methods, they are more likely to be a development organisation that undertakes large projects, uses a larger number of risk analysis methods and has more layers in the project approval process.

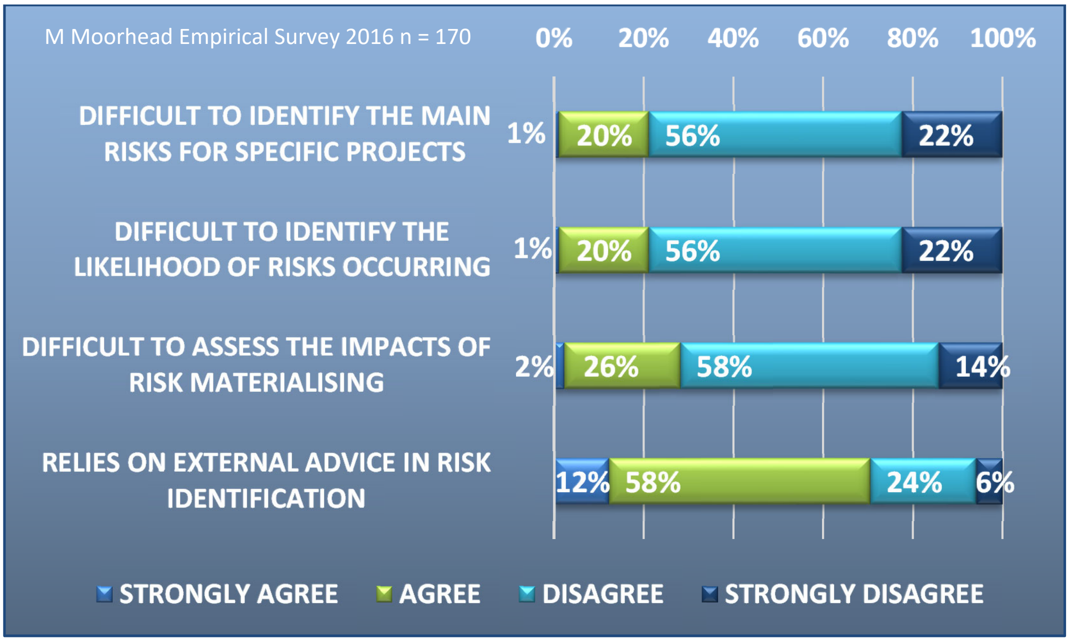
6.5.4 Project risk identification and risk management processes

Please evaluate the following aspects/features of your risk management process at the pre-commitment stage of the project development process.

This question aims to give an understanding of respondent organisation risk identification practices and culture during the pre-commitment stages of the development process. This question was patterned after Wiegelmann (2012, p. 134), but differs in that the focus is on the early stages of the site acquisition and the go/no-go decision process rather than across the complete development process as a whole.

It is generally accepted that organisations should aim to identify the key risks of a potential project early in the decision process and assess the impact of these risks on both the project and the organisation as a whole. This step naturally must occur before any active risk management strategies are implemented and form an essential part of the due diligence activities of property development organisations. The results of the risk identification questions are presented in Figure 6.5.4a and a comparison to the results found in Wiegelmann (2012) are presented in Table 6.5.4.

Figure 6.5.4a: Project risk identification in the pre-commitment stages of the property development process



Source: Author, 2018

The result of this question demonstrates that the majority of respondents either strongly disagree or disagree with the three statements concerning the difficulty in the identification of risks demonstrating a high level of confidence in their organisation's overall risk management process. This result is similar to that which was found in Wiegelmann (2012) concerning European property development organisations. Additionally, Newell and Steglick (2006) found 100% of respondents, which were ASX publicly listed property developers, had a system of risk identification prior to the commencement of a development project.

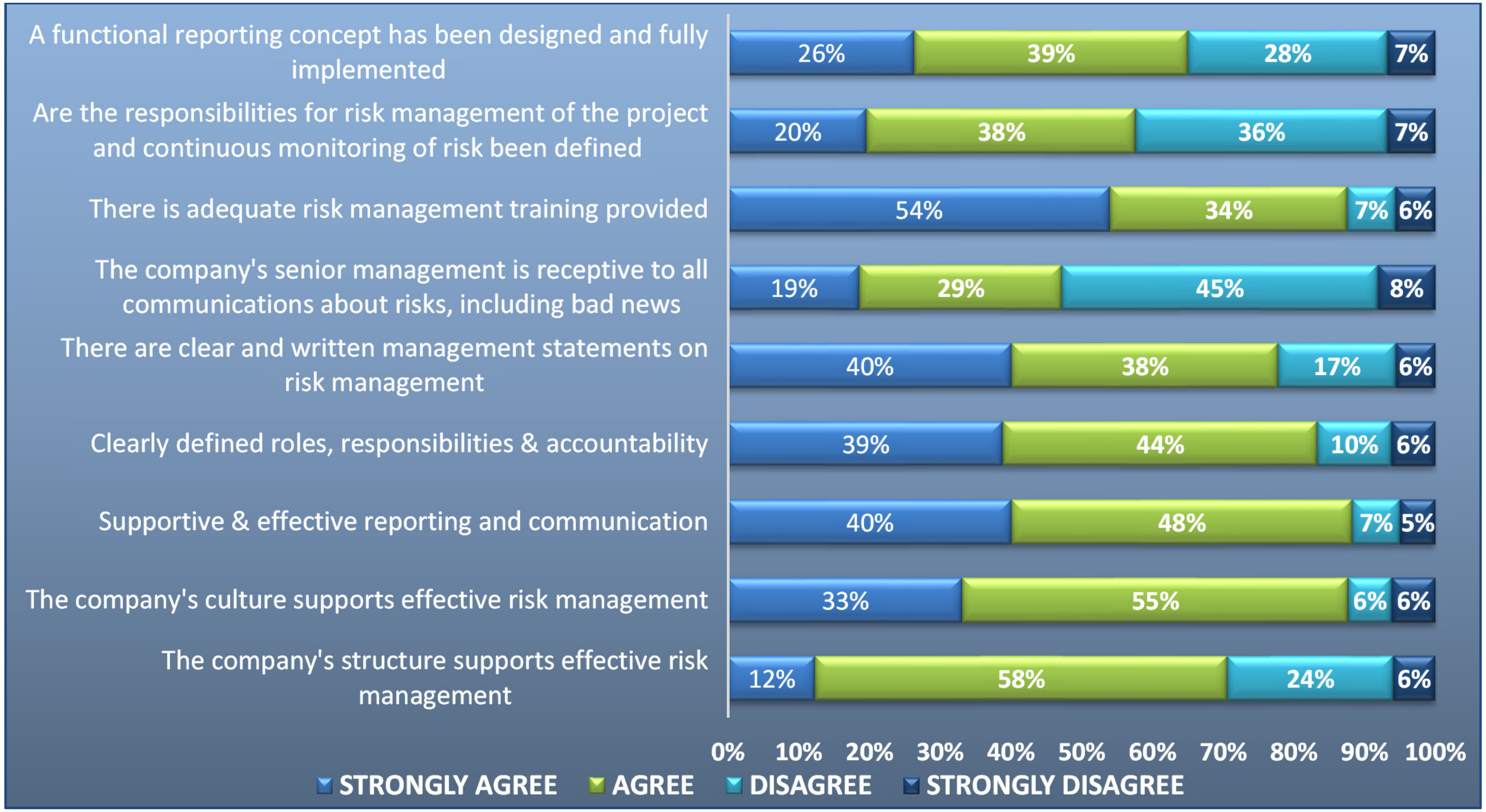
Table 6.5.4: Project risk identification question comparison to Wiegelmann (2012)

Project risk identification	% that disagree or strongly disagree Wiegelmann (2012)	Moorhead (2016)
Difficult to identify the main risks for specific projects	92.70%	81.20%
Difficult to identify the likelihood of risks occurring	72.10%	78.82%
Difficult to assess the impacts of risk materialising	80.90%	71.76%

Source: Author, 2018

When respondents were asked specifically about aspects of their organisation's risk management practices, the overall level of confidence is reduced when expressed in terms of the organisation's management and its attitude to risk identification. Respondents were asked to evaluate the aspects/features of their organisation's project decision-making process and the results are presented in Figure 6.5.4b.

Figure 6.5.4b: Risk management processes



Source: Author, 2018

Please evaluate the following aspects/features of your risk management process at the pre-commitment stage of the project development process.

Two particular areas which include ‘the company's senior management is receptive to all communications about risks, including bad news reception to the levels of confidence is reduced’, and ‘the company's culture supports effective risk management’ demonstrated a lower level of confidence. This result indicates that even though respondent organisations believe that they have systems in place to adequately identify and manage risks to their projects, the cultural aspects does not encourage decision-makers to actively identify risks and report them.

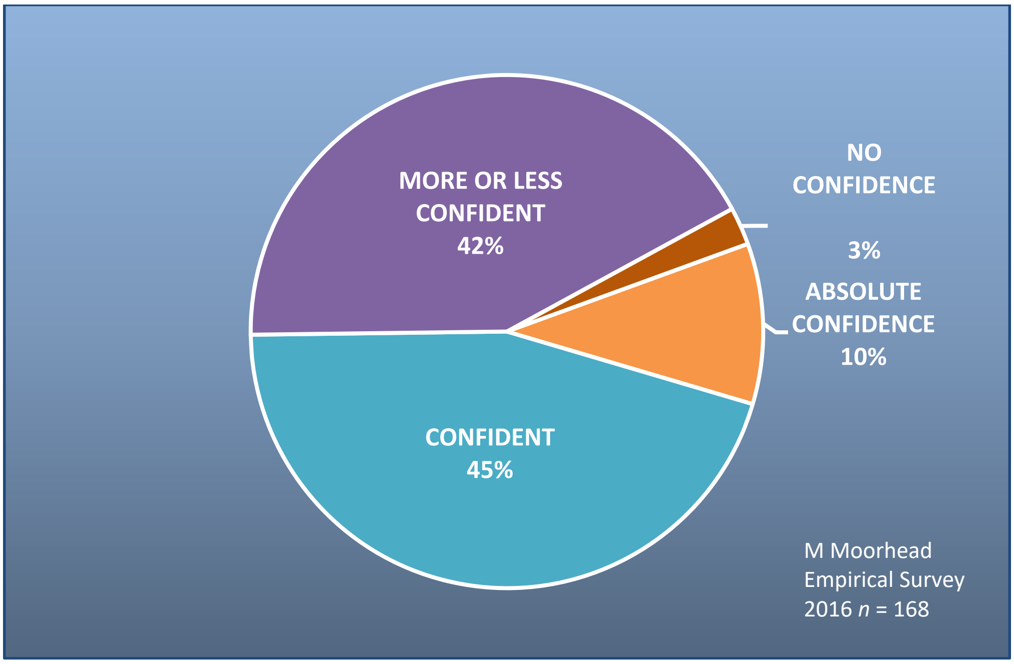
Areas, where high levels of confidence were indicated by survey respondents, included the provision of risk management training, having clear and written management statements on risk management, and having a supportive and effective reporting and communication process and the company’s culture supports effective risk management. These results appear to contradict those areas where there was a lower level of confidence displayed. This result is not dissimilar to other studies (e.g. Wiegelmann, 2012) where a high level of confidence in the organisation's risk management practices is not reinforced by the specific attributes of the risk management process.

6.5.5 Confidence in risk analysis and management

How confident are you that your company is identifying and preparing for potentially significant risks in potential projects at the pre-commitment stages of the development process?

When respondents were asked to indicate their level of confidence in relation to their company identifying and preparing for potentially significant risks in potential projects at the pre-commitment stages of the development process, 10% indicated absolute confidence, 45% confidence, 42% were more or less confident and only 2% had no confidence. The results are illustrated in Figure 6.5.5 and Table 6.5.5. This result demonstrates an overall moderately high level of confidence in their organisation's risk management and identification practices. This result is more optimistic than that found by Wiegelmann (2012) where the majority of European developers indicated a moderate to a moderately low level of confidence, though a comparison is difficult as the difference could be attributed to the market conditions facing the property development industry in each region at the time of the survey.

Figure 6.5.5: Confidence in risk identification at the pre-commitment stages of the property development process



Source: Author, 2018

Table 6.5.5: Confidence in risk analysis and management

	Responses	% Responses
Absolute Confidence	17	10%
Confident	76	45%
More or less confident	71	42%
No confidence	4	2%
Total	168	100%

Source: Author, 2018

6.5.6 Summary of responses to qualitative questions

Does the organisation where you are employed have a risk management strategy that is incorporated into feasibility analysis?

Survey participants were asked to indicate if the organisation for which they are employed have a risk management strategy incorporated into their feasibility analysis practices. The results of this question are presented in table 6.5.6a and demonstrate that the majority of respondents (75%) indicated that a risk management plan was in place, but 32% indicated that improvement is needed. Only 25% of respondents indicated that the organisation for which they are employed did not have a risk management strategy.

Table 6.5.6a: Respondents organisation has a risk management plan

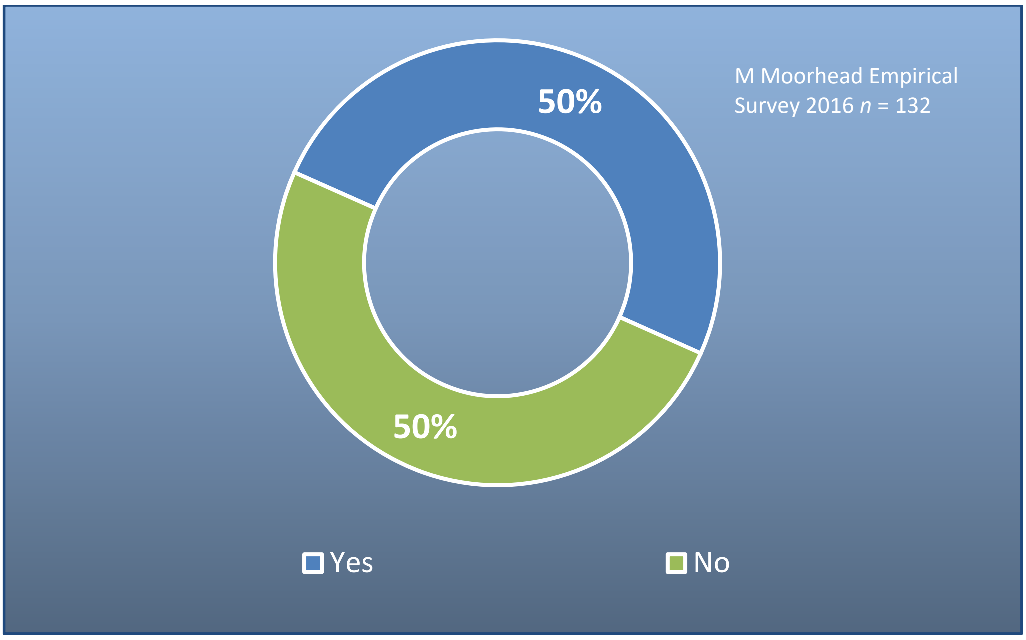
Risk Management Plan	Responses	% Responses
Yes, implemented	75	42%
Yes, but needs improvement	57	32%
No, but planned	16	9%
No	29	16%
Total	177	100%

Source: Author, 2018

Has your company's risk management policy changed significantly over the last seven years as a result of the global financial crisis?

The 132 respondents who answered in the affirmative that the organisation for which they are employed has a risk management plan, were also asked to indicate if the organisations' risk management plan had changed as a result of the GFC. This question received a 100% response rate from the 132 eligible respondents, with 50% indicating the organisation for which they are employed had indeed changed its risk management policy as illustrated in Figure 6.5.6.

Figure 6.5.6: Organisation change of risk management policy as a result of the GFC



Source: Author, 2018

For the 66 respondents who indicated a change in their organisations risk management policy as a result of the GFC, were then asked to describe the changes to their organisations risk management policy in an open-ended question, of which 45 responses were received with (100%) indicating an increase in the risk analysis practices as a result of the GFC The responses were quantitised, in the process discussed in section 5.4, into five categories which are presented in table 6.5.6b.

Table 6.5.6b: Categories of risk policy change

Risk Policy Change Categories	Responses	% Responses
Increased qualitative frameworks and less prescriptive	10	22%
Greater focus on risk awareness (more qualitative)	8	18%
Increased quantitative risk analysis	11	24%
Change in funding arrangements (debt or equity)	7	16%
Other	9	20%
Total	45	100%

Source: Author, 2018

The frequency of results after the open-ended questions were coded into categories did not reveal any dominating theme, with the per cent of responses ranging from 16% to 24% with the category of increased quantitative risk analysis and increased qualitative frameworks receiving the highest number of responses.

A recurring theme in the qualitative frameworks category was the inclusion of a risk register and risk catalogue to allow for decision-makers to plan for mitigation and possible transference strategies once risks were identified. Specific examples of responses found within this theme are given as follows:

> *Example 1: There is a greater focus on market risk with respect to forecast growth assumptions, however, the company does not utilise a proper risk matrix to assess likelihood and consequence to ascertain a cost/revenue impact to the project. Scenario analysis is undertaken to consider changes in forecast, but this is not used to quantify risk.*

(Senior Development Manager / Medium-Large Project Size/ Primary Residential Type/ Private Company/ 5 - 10 years experience)

Example 2: A higher level of approval required at acquisition. Greater research into market depth. Risk register and catalogue to allow for a downturn strategy.
(Senior Development Manager / Medium-Large Project Size/ Primary Residential Type/ Publicly Listed Company/ 10+ years experience)

Example 3: 1) Introduction of an oversight and risk review group, who are required to review and approve all acquisitions over $5m against a set of pre-determined risk strategies. This provides an arm's length evaluation of assumptions and risk. 2) Our company is also less likely to purchase sites with any planning risk. In addition, there has been a focus on purchasing assets "off-balance sheet" with capital partnering, joint ventures or "staged" acquisitions.
(Development Manager / Large Project Size/ Primary Residential Type/ Publicly Listed Company/ 2 - 5 years experience)

Example 4: Maintaining a live risk register that is reviewed on month by month basis.
(Development Manager / Large Project Size/ Primary Mixed-Use Type/ Publicly Listed Company/ 5 - 10 years experience)

Example 5: Payment of land value linked to key milestones to de-risk property. Much more emphasis on demographic information and greater emphasis on quantity surveyor reports.
(Development Manager / Medium-Large Project Size/ Primary Residential Type/ Publicly Listed Company/ 5 - 10 years experience)

In the increased quantitative analysis category, a recurring theme was the use of more sophisticated risk analysis techniques in their organisational feasibility analysis practices. Specific examples of responses found within this theme are given as follows:

> *Example 1: At the start of my involvement where I work, which was some time ago, risk analysis was pretty much limited to sensitivity analysis within the feasibility study. Towards the end of my involvement, it included detailed Monte Carlo profiling of both cost and time aspects as well as revenue streams*
> *(General Manager / Medium-Large Project Size/ Primary Residential Type/ Private Company/ 10+ years experience)*

> *Example 2: More stringent stress testing of Cash Flow Models, and also it is important for land values to be assessed on both a direct comparison and hypothetical cash flow basis. The model may indicate a residual value, however, it still needs to be supported by analysed sales (as much as possible). Valuers tend to get in trouble once they place too great a reliance on cash flow models only, with little regard or support provided by comparable site sales.*
> *(Senior Development Manager / Large Project Size/ Primary Residential Type/ Private Company/ 10+ years experience)*

> *Example 3: More thorough scenario and sensitivity analysis in feasibility analysis.*
> *(Senior Development Manager / Small Project Size/ Primary Residential Type/ Private Company/ 10+ years experience)*

> *Example 4: Financial metrics are much better scrutinised and identified risks are far more rigorously examined with sensitivity analysis.*

(Senior Development Manager / Large Project Size/ Primary Residential Type/ Publicly Listed Company/ 10+ years experience)

Within the risk awareness and quantitative analysis theme-specific examples of responses are given as follows:

Example 1: Typically the changes have been around the funding arrangements and our own internal hurdles on preselling or underwriting potential capex of a project prior to the commitment.
(Senior Development Manager / Medium-Large Project Size/ Primary Residential Type/ Private Company/ 5 - 10 years experience)

Example 2: Independent risk and quantitative analysis team now checks projects before acquisition.
(Development Manager / Small Project Size/ Primary Other Development Type/ Publicly Listed Company/ 2 - 5 years experience)

Example 3: More punitive risk-adjusted discount rates. Build a better balance of cashflow producing assets with low risk, and high risk/profit development projects that don't require profit to be drawn to maintain overheads.
(Senior Development Manager / Large Project Size/ Primary Tourism Type/ Publicly Listed Company/ 10+ years experience)

Specific examples of responses regarding the theme of a change in funding arrangements to debt or equity are given as follows:

Example 1: We now have much larger cash reserves in our business that we will not go below under-any circumstances. If we forecast a short

term gap in development trading income that will potentially result in this cash buffer being eroded, we will often pay a premium to use private equity for a short period of time to ensure these cash reserves can be maintained.
(Assistant Development Manager / Medium-Small Project Size/ Primary Residential Type/ Private Company/ 2 - 5 years experience)

Example 2: Seeking lower LVR's, Increased Scenario Analysis, and doing smaller stages.
Senior Development Manager / Medium-Small Project Size/ Primary Residential Type/ Private Company/ 10+ years experience)

Example 3: Depending on the client and their equity input. Some clients are able to bring significant amounts of equity into their projects. This is aligned with their company vision and structure. Equity input from these clients are on long-term projects such as land subdivisions and mixed-use developments. If debt funding is required it is part of the due diligence process to liaise with potential lenders to determine their hurdle rates (LVR, construction lend capacity, fees etc.). Put simply there isn't a true change from our company's perspective. This is because the Client's ability to provide equity and their ability to lend will change on a project per-project basis. Also, changes in banking circumstances also provide significant changes to financial risks and lending criteria.
(Assistant Development Manager / Large Project Size/ Primary Residential Type/ Private Company/ 2 - 5 years experience)

Example 4: More equity required each deal so harder to get grasp up to hurdle return. Usually, initial purchase fully equity funded. Approvals and time frames as closely monitored.

(Senior Development Manager / Medium-Large Project Size/ Primary Residential Type/ Publicly Listed Company10+ years experience)

6.5.7 Determination of research question RQ 8:

RQ 8: Are Australian and New Zealand property development companies confident in their organisation's risk identification and management practices in the decision-making processes of the pre-commitment stages of the development process?

Findings RQ 8:

Survey respondents demonstrated a high level of confidence in their organisation's ability to both identify and manage risks that could be encountered by potential property development projects. This confidence is similar to that found by Wiegelmann (2012) but is not supported by the actual risk management processes. The majority of property developers surveyed (75%) indicated the organisation which they work for has a risk management plan, and 42% indicated that the plan is implemented, with 32% indicating that improvement is needed. Only 25% of respondents indicated their organisation not having a risk management plan. Of those that do have a risk management plan, half indicated that the plan has changed as a result of the GFC.

Specific examples of changes to their organisational risk management practices indicated an increased focus on risk analysis which can be broadly categorised into four themes which are an increased qualitative frameworks, an increased in methods of quantitative risk analysis analysis, an increase in risk awareness and associated quantitative analysis and a change in funding arrangements to debt and/or equity. Examples of changes to decision-practices, in regards to risk identification and management, were given including maintaining a live risk register and risk catalogue to allow for organisational risk mitigation and risk transference strategies, alternate debt and/or equity strategies including securitisation of equity contributions to projects, the use of more sophisticated quantitative risk analysis techniques such as Monte-Carlo probability simulations and adjusted hurdle and discount rates based on project planning approvals and the outcome of a potential projects risk analysis.

6.5.8 Contribution of responses concerning risk analysis, risk management processes and organisational cultural aspects of property developers

Section 6.5 provided a narrative of the cultural aspects of respondent organisations with respect to risk tolerance and attitudes. Additionally, respondent risk analysis and management practices were examined with regards to the demographic characteristics of respondents.

6.6 Summary

This chapter provided a discussion of the results found through the analysis of the data collected in the research instrument as part of the research methodology. The results were presented in terms of the survey respondent organisations in describing their key characteristics and demographics, the organisation's decision processes and hurdle rate adoption, the organisation's feasibility analysis practices and the organisation's risk analysis and cultural environment.

The primary goal of the analysis of the results was to address each of the research aims and answer the research questions that were discussed in detail in Chapter 5 and make a contribution to the limited academic research that has been previously undertaken concerning the decision-making, hurdle rate selection and altering and the feasibility analysis practices of Australian property development organisations in determining a projects viability and the selection of potential projects in the pre-commitment stages of the property development process. Chapter 7 will present a summary of the findings, outline the key recommendations that have been formulated as a result of the analysis of the results and also present opportunities for further research.

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Chapter 7: Recommendations and further research

> *Little is known regarding either the expected or achieved rates of return for property development schemes. This lack of transparency is in contrast to the situation for investment properties where the formation of target return rates has been explored… Many participants in real estate development are not formally benchmarked and academic investigation of how developers form required rates of return is limited. (Crosby, Devaney & Wyatt, 2018a p. 1-2)*

Chapter 6 presented the results of the analysis of the data collected from survey participants in order to address the primary aims of this research. These aims include an examination of the decision-making practices in determining project viability through feasibility analysis within real estate development firms in Australia and also obtaining information regarding hurdle rate selection and techniques commonly utilised to determine project viability. This research investigates the drivers and decision-making processes of property developers in Australia but also touches on the global practices of the industry as property development becomes increasingly internationalised.

An additional research aim was to examine if decision-makers within the industry utilise generic hurdle rates, industry rules of thumb and benchmarks when deciding to proceed with a project in the pre-commitment stages of the property development process. The *pre-commitment stages* refer to those stages in the development process prior to a go/no-go decision point and before site acquisition or project commencement. The final research aim includes an examination of the risk analysis, risk identification and management practices, including the use of Monte Carlo simulations, Bayesian models and Real option theory in property development decision-making as instruments for providing flexibility and managing risk, uncertainty and change.

This research investigation has made a contribution to knowledge by informing on the gaps within the literature and prior academic studies, as more fully discussed in Chapter 6. The research questions were designed to address each of the research aims, originating from both the literature review, predicated on the author's professional practice. The key findings are summarised in section 7.1.

7.1 Review of the literature from Chapters 2 - 4

Within the framework of this research thesis, chapter 2 outlined and described a number of development process models that illustrate the process used by real estate development firms in order to bring a development project from initial concept and obtaining permissions through to completion, handover and the managing of the asset over its lifecycle. Additionally, property developer typologies were identified and defined; types of property development projects commonly undertaken were outlined; an overview of the Australian property development industry given; and finally, an original definition of property development was provided.

Chapter 3 provided a review of the literature and theory regarding the practice of determining project viability in property development projects through the use of feasibility analysis. The recent history and evolution of feasibility analysis practices for property development were also discussed. The practical aspects of completing a feasibility analysis for a project was addressed. Decision methods and hurdle rate selection were discussed and past research concerning the application and use of hurdle rates in decision making literature was reviewed. Particular methods of determining site value were discussed including the traditional static residual land value method, the dynamic methods of discounted cash flow and the residual accumulation cash flow method and the market comparison method.

Within existing academic literature, there remains a scarcity of understanding and analyses concerning the uptake and acceptance of the various risk measurement and mitigation techniques applied by property developers in the Australian markets. Chapter 4 investigated the techniques being incorporated into the decision-making process during the pre-commitment stage of the development process and how property developers adjust their decision-making processes in light of a predicted change in project risk.

To this end, a literature review has been completed in respect of the broader property development process as well as the determination of project viability through feasibility analysis. The review of the current academic literature identified only a few studies that have sought to make a thorough investigation of the practices used within the property development industry, the principal studies which include Newell & Steglick (2006); Civan (2007); Atherton *et al.* (2008); Gehner (2008), Costello & Preller (2010); Loizou & French (2012); Wiegelmann (2012); Coleman *et al.* (2012), Crosby *et al.* (2018a) which outlined key decision hurdle rates and identified innovative practices that have been developed including the use of Monte-Carlo simulation and Bayesian models. From this supportable foundation, and generated from relevant published sources, the status of informed, contemporary opinion on the decision models within the property development process have been illustrated. However, these studies were limited as they did not identify the extent of adoption or use of these methods and, in particular, the selection and altering of hurdle rates as a decision basis within the property development industry in Australia. As a consequence, the merits of the views of Crosby, Devaney & Wyatt (2018a) and other commentators concerning the limited knowledge the manner in which property developers determine rates of return or the viability of potential projects could then be considered with greater insight. As an outcome of the literature review, it was appropriate to inquire further into the practices of the property development industry in Australian and New Zealand, which was evidently not well documented, and to present empirically a view of the current decision-making and hurdle rate selection practices for comparative analysis.

7.2 Summary of Findings

The results of the statistical analysis have been presented in order to provide a broad level of understanding of industry practice and answer the research questions presented in Chapters 1 and 5. The following sections provide a summary of the results and findings for each research question. Notwithstanding the limitation of applying the results of respondents in a survey of the industry as a whole or the other limitations of this study discussed in section 5.12, the following section will generalise the results of the survey responses as applied to the broader property development industry in Australia.

7.2.1 Research Aim 1 – The role of feasibility analysis and hurdle rate selection in management decision making and determining viability in the pre-commitment stages of the development process

The majority of Australian property development organisations do utilise specific go/no-go hurdle rate mechanisms as a decision basis for proceeding beyond the pre-commitment stages of the development process.

In particular, the use of MDC and IRR as specific hurdle rate metrics are incorporated into the decision to proceed with potential projects. Additionally, a large majority (72%) of property developers use either one or two specific hurdle rate metrics as the basis of decision making. Property developers who do not use specific hurdle rates are more likely to use a qualitative framework as a basis for decision-making.

Dominant property typologies

Differences between dominant property typologies for Australian and New Zealand property developers were examined and found that there were no significant differences between typologies in the use of specific go/no-go decision processes. Additionally, there were no differences in the use of primarily quantitative or qualitative methods as a basis for project decisions at the acquisition or commencement stages of the property development process. Specific hurdle rate metrics including MDC, IRR, ROE and NPV were tested to ascertain if significant differences existed in their usage between the residential, commercial, retail, industrial, tourism or other property typologies. A significant difference was found in the residential dominant developer category which was more likely to use an MDC as a hurdle rate metric. No other significant results were found among the remaining dominant property typologies in the use of IRR, ROE and NPV.

In addition to testing for the use of specific financial metrics, the specific level or percentage adopted was also examined among the differing property typologies. When the specific level of MDC adopted was examined, there was found to be no statistically significant difference between the individual dominant property type categories, and the reason for this will be explored further in the summary of Research Aim 2. When the specific percentage of IRR used as a hurdle rate was examined, it was found that the residential dominant category required a higher minimum IRR percentage than that of the retail and mixed-use dominant categories. Additionally, the ‘other’ property dominant type category, which included both industrial and childcare developer respondents, it was found that the adopted percentage rate of IRR was higher than that of the retail category and was very close to the 20% mean result of the residential dominant category. These results demonstrate the perception that residential and mixed-use property type categories reflect a higher required risk/reward trade-off than those of retail and commercial property development projects.

Preferred project sizes and public versus private ownership structures

The differences between large, medium and small projects were analysed, as well as the differences between those developers who use a public versus a private ownership structure. In relation to project size, the results demonstrated that developers who undertake large project sizes do utilise more sophisticated methods of feasibility analysis and have a higher number of specific hurdle rates as a basis for project selection and proceeding beyond the pre-commitment stages of the development process. This result is in line with what was expected, as those who undertake larger projects typically have more capital at risk and it was anticipated that more resources would be dedicated to the determination of project viability.

However, public versus private ownership structures did not influence the choice or the number of hurdle rates used as a decision basis. It was anticipated that publicly listed developers would use more specific financial metrics, both in number and complexity, in order to determine project viability; however, statistically significant differences were not found. The results also demonstrate that developers who undertake smaller projects adopt a higher percentage of ROE as a hurdle rate. One explanation for this result is that smaller projects have more access to debt capital which would necessarily increase the ROE percentage required, given the use of other hurdle rates such as MDC and IRR which are not as heavily influenced by a project's gearing. Additionally, a strong association was found between the use of ROE as a hurdle rate and using multiple hurdle rates in decision-making, indicating this was a secondary hurdle rate metric in addition to the use of MDC or IRR. The results found only a small incidence of use of NPV as a project decision-making hurdle rate, and preferred project size and ownership structure had no significant association with the use of this hurdle rate. This result was surprising given the prominence of NPV in the financial decision-making academic literature.

Project size also influenced a developer's use of IRR as a hurdle rate, although the preferred project size and ownership structure had no significant association with the specific percentage level adopted. Additionally, there was no association found between preferred project size and ownership structure and the use of a specific percentage level of MDC adopted as a hurdle rate.

The results also indicate that the structure of many development projects are complex and the boundaries between traditional speculative development and property investment through the use of securitisation methods have become more difficult to distinguish. Additionally, the results show that the majority of development organisations in this survey did not rely purely on quantitative metrics of project viability to make decisions but also use qualitative methods and organisational specific structural checks and balances as a method of managing the organisation's risk. Even though the majority of responses indicate that development organisations rely on a single level of organisational approval, the nature of that approval is at the corporate board or executive level rather than at the level of the project manager. Smaller development organisations which do not have boards or a formal risk management process are more likely to require the approval of the General Manager.

Developer typologies

The results of the analysis demonstrate that differences exist in the selection and use of hurdle rates based on developer typologies. Investor Developers are more likely to use the payback period as a hurdle rate and Trader Developers and Development Managers are both more likely to use MDC and also to use specific hurdle rates as a part of a go/no-go decision. Additionally, Trader Developers adopt a higher percentage of IRR as a metric than do the other key developer typologies which may reflect the higher level of risk inherent in the more speculative nature of the development process for Trader Developers than for Investor Developers. It is also relevant to note that Trader Developers deviate further from accepted financial theory in hurdle rate selection than do Investors Developers.

Experienced versus novices and having a property related qualification in hurdle rate section and usage

The results of the analysis demonstrated that there were no differences between experienced versus novices in terms of their use of go/no-go hurdle rates, the usage or specific levels of key hurdle rates, the number of hurdle rates used or in the number of variables forecasted to aid in decision-making based on experience levels. These results were different from those anticipated and is an area for further research. Additionally, the results also demonstrate that there is little difference between decision-makers who have a property qualification and those who do not, with the exception that they were more likely to use specific hurdle rates in their decision-making processes.

Differences between New Zealand and Australian property developers in their selection and usage of hurdle rates and decision-making practices

New Zealand developers demonstrated a lower usage of specific hurdle rates as part of their decision-making processes than did Australian based property developers, where the vast majority use specific go/no-go hurdle rate metrics. However, the results of the analysis demonstrated that for those in Australia and New Zealand who do use specific hurdle rates in decision-making, significant differences were not found with the exception of New Zealand based property developers who were more likely to use the *Minimum Profit* dollar amount and *Minimum Project Size* dollar amount than were Australian based property developers.

Differences between a multi-national and domestic scope of property development regarding the selection and usage of hurdle rates and decision-making practices

The results indicated that multi-national property development organisations operating in multiple geographic regions demonstrated a higher use of qualitative frameworks as a decision-making process and lower use of MDC as a hurdle rate. This result is the opposite of that of Australian and New Zealand developers operating in their domestic markets. This result demonstrates that those firms that operate across multiple national markets need to incorporate more flexible and complex decision-making than developers operating in a single national market.

Feasibility analysis practices and the use of proprietary or bespoke feasibility analysis programs

The feasibility analysis practices of Australian property developers were analysed in terms of the variables forecasted, the retrospective checking of forecasted variables, the use of Microsoft Excel in determining project viability, proprietary and bespoke feasibility analysis software and the methods of feasibility analysis utilised as well as the methods of determining a site's value prior to project commencement.

In terms of the most frequently forecasted variables, they included the variables of gross sales in dollars per square metre, the supply of comparable property (sales value), the yield of comparable properties, the percentage market capture of sales (demand), capitalisation rates and interest rates. The only frequently forecasted variable that is a macro-economic indicator was found to be interest rates with all other frequently forecasted variables being concerned with the microeconomic aspects of the property market. Additionally, the frequency of usage of variables indicates information that is either from the past (such as comparable sales or leasing data) or variables that give a reflection of the current state of the market. In terms of developers retrospectively checking their forecasted variables, the majority of developers do go back and check their forecasts in order to learn from their results and improve their forecasting practices.

In terms of developer feasibility analysis practices and the use of feasibility analysis programs, the two most frequently used tools included Microsoft Excel (46%) and Argus Estate Master DF (37%), with other proprietary feasibility analysis programs usage being less than or equal to 5 per cent. In terms of developers who use a proprietary feasibility analysis program other than Microsoft Excel, and those who do not, six key differences were found. First, a key difference included being more likely to use specific hurdle rate metrics to decide to proceed with a project beyond the pre-commitment stages of the development process. Second, they were more likely to utilise a specific hurdle rate metric in determining project viability and interestingly were also more likely to alter or adapt hurdle rates given a change in project uncertainty or risk. Third, they were more likely to use MDC as a hurdle rate metric, but there was no difference in the percentage level adopted. Fourth, those who use proprietary feasibility analysis programs also use a higher percentage of IRR as a hurdle rate but are no more likely to use ROE or MOR. Fifth, the number of variables used in forecasting, the number of approval levels required to proceed and the mean years of experience of decision-makers were not found to be significantly different. Finally, in terms of the use by developers who use bespoke property development programs and those who do not, differences were found based on both the preferred project size and also whether the organisation is publicly listed or not.

The use of the residual land value method, the discounted cash-flow method, the residual accumulation cash flow method and/or the market comparison method for determining a potential development site's value by Australian and New Zealand development companies

It was found that in the pre-commitment stages of the development process the primary methods used included the residual land value method and the discounted cash flow method to value a site. The residual accumulation cash flow method (RACFM as discussed in section 3.3.4) and the market comparison method were not widely used. Additionally, developers with more than ten years' experience are more likely to use the residual land value method than less experienced respondents. Experience levels did not play a significant factor at all in the use of the discounted cash flow method, the residual cash flow method accumulation or the market comparison method.

7.2.2 Research Aim 2 – The relationship between bounded rationality and heuristic bias in management decision-making by Australian and New Zealand property development organisations

Do Australian property development organisations have a pre-determined process and method of altering or adapting chosen hurdle rates, and do they specify and change the required hurdle rates and benchmarks as a basis of go/no-go decisions in light of increased risk and uncertainty?

The majority of developers in Australia do not have a pre-determined process and method for altering or adapting the chosen hurdle rates and benchmarks, even in the presence of an expected change in uncertainty and risk to a potential project. It was found that for developers who do alter their hurdle rates, the primary basis for that change can be categorised by three themes including altering hurdle rates on the basis of risk analysis and forecasted market conditions, altering hurdle rates based on qualitative frameworks or intuition and altering hurdle rates based on the project's status of planning approval. The most important variables in predicting whether developers alter their hurdle rates include the developer typology, the type of property developed, education level and whether the decision-maker uses MDC or IRR as a hurdle rate.

The demonstration of bounded rationality in the decision-making processes of Australian and New Zealand property developers

The results demonstrate a heavy reliance on industry-accepted rules of thumb for both selecting and setting the specific level of hurdle rate metrics used to decide whether to proceed with a development project beyond the pre-commitment stages of the development process. Additionally, it is interesting to note that the selection and usage of specific hurdle rates did not change even when there was a perceived change in the risk or the uncertainty of a project.

The rationale for the choosing and setting of minimum hurdle rate metrics is based largely on experience, intuition and the minimum accepted benchmarks set by providers of capital finance to the property development industry. Residential developers and the typology of Trader Developers were more likely to rely on a narrow range of MDC (median 20% and standard deviation of 1.41%) and IRR (median 18% and standard deviation 4.85%) percentages.

7.2.3 Research Aim 3 – Consider the use of Monte Carlo simulations, Bayesian models and option theory, real and embedded options in long-term property development and investment decision making as instruments for providing flexibility and managing risk, uncertainty and change.

Do Australian and New Zealand property developers use sophisticated theory-led structured quantitative analysis in the feasibility analysis models used in the decision-making processes in the pre-commitment stages of the development process?

The results found few development organisations use sophisticated quantitative risk analysis methods such as Monte Carlo simulation, Real Option theory and probability/Bayesian models in their decision making at the pre-commitment stages of the development process. Of those who do use these methods, they are more likely to be a development organisation which undertakes large projects, uses a larger number of risk analysis methods and has more layers in the project approval process.

Do Australian and New Zealand property developers demonstrate confidence in risk identification and management practices in the decision-making processes in the pre-commitment stages of the development process?

The results demonstrated that decision-makers in Australian and New Zealand property development organisations possess a high level of confidence in their organisation's ability in both the identification and management of risks which may be encountered in a potential property development project. This confidence is similar to that found in other studies; however, this is not supported by the actual risk management processes used by property development organisations revealed by this research. The majority of property developers (75%) indicated the organisation which they work for has a risk management plan, and 42% indicated that the plan is implemented, with 32% indicating that improvement is needed. Only 25% of respondents indicated their organisation not having a risk management plant. Of those that do have a risk management plan, half indicated that the plan has changed as a result of the GFC.

Specific examples of changes to their organisational risk management practices indicated an increased focus on risk analysis which can be broadly categorised into four themes which are increased qualitative frameworks, an increased in methods of quantitative risk analysis analysis, an increase in risk awareness and associated quantitative analysis and a change in funding arrangements to debt and/or equity. Examples of changes to decision-practices, in regards to risk identification and management, were given including maintaining a live risk register and risk catalogue to allow for organisational risk mitigation and risk transference strategies, alternate debt and/or equity strategies including securitisation of equity contributions to projects, the use of more sophisticated quantitative risk analysis techniques such as Monte-Carlo probability simulations and adjusted hurdle and discount rates based on project planning approvals and the outcome of a potential projects risk analysis.

7.3 Recommendations

A large quantity of data has been collected, analysed and then synthesised from the perspectives of the background literature, focused property development decision-making literature and from the empirical data collected. The synthesis and analysis of these elements, of which this study is comprised, has allowed the formulation of a number of recommendations for the Australian and New Zealand property development industry in respect of determining potential project viability in the pre-commitment stages of the development process. The key recommendations are summarised in the following:

- In relation to short term projects- less than three years in total- and when conducting speculative based property development projects, decision-makers should not focus on IRR or other time-weighted metrics as a method of comparison between projects, but adopt simpler short term measures such as ROC or MDC.

- Property development projects that occur over a period longer than three years should use a hurdle rate financial metric based on the time value of money, such as the DCF methodology, in order to determine the development site's residual land value as well as a potential project's NPV and IRR. However, if decision-makers continue to rely on a simple MDC or ROC method, there should be an adjustment in the required MDC for a longer-term project to account for time.

- For potential projects where the primary purpose for undertaking the project is for investment purposes, or build to rent, then IRR and other time-value of money based financial metrics should be adopted as well as TIRR for the determination of a go/no-go decision basis.

- The property development field of research should not blindly follow the broader financial investment research that is focused on regular recurrent income. Research into the decision practices of property development projects should also seek to incorporate specific indicators that cater to short term speculative development projects.

- The property development industries in Australia should be aware of the changing political and societal landscape that will place a higher emphasis on the long-term outcomes of projects rather than a 'develop and forget' model.

- Notwithstanding the requirements that providers of capital for property development projects demand a project must achieve a minimum of 20% return on capital, property development organisations should also have independently determined project hurdle rates as an aid to decision-making. These hurdle rates should be based on the organisation's opportunity cost, WACC and also an additional risk premium determined by the forecasted risk and uncertainty of the key variable inputs of a potential project.

- Property development organisations should utilise a pre-determined process and method of altering or adapting the chosen hurdle rates and benchmarks along the basis of a number of criteria including:
    - The level of risk and uncertainty concerning input variables which must be forecasted
    - The type of planning approval already obtained or required for the potential project

- The level of risk and uncertainty perceived from analysing a potential project's key variable inputs
- The level of risk and uncertainty perceived in the broader property market
- The level of risk and uncertainty perceived in the general economy.

- In order to incorporate the recommendation of having a pre-determined process and method of adapting hurdle rates, property development decision-makers, if using simple MDC, ROC, ROE or ROR decision metrics, should also utilise a time value of money hurdle rate. This allows for varying risk premiums commensurate with the anticipated risk and uncertainty in a potential project.

- Property development organisations should incorporate more modern and sophisticated models of risk analysis in order to determine the uncertainty of, and risk in, a change of input variables in their financial viability appraisals. In recent times there have been advances in proprietary feasibility analysis programs and Microsoft Excel add-ins that are readily available and which offer the use of Monte-Carlo stochastic simulations and other probability-based quantitative techniques. Property development organisations in Australia should utilise these specific techniques in the pre-commitment stages of the property development process and, specifically, in the site acquisition process to support decision-making.

- In conducting a feasibility analysis to determine financial viability in the pre-commitment stages of the development process, property development organisations should utilise specific debt and equity structures in their modelling. These are more practical and realistic for their purposes than relying on the 100% finance method often represented in the literature and employed by valuation firms to determine site value.

- In conducting feasibility analysis to determine financial viability in the pre-commitment stages of the development process, property development organisations should incorporate qualitative risk analysis methods including a live risk register and catalogue of risks, including identification of and plans for mitigation of project risks, as a form of risk management.

This section has presented the key recommendations of this study in terms of decision-makers who are engaged in the process of determining the financial viability of potential projects in the pre-commitment stages of the development process in the Australian and New Zealand property development industry. The following section outlines the areas of contribution to the body of knowledge that has resulted from undertaking this study.

7.4 Contribution

The findings and results of the empirical survey addressing the research questions in each of the research aims have revealed a degree of consensus from decision-makers in property development organisation in Australia. This consensus in the use and application of hurdle rate metrics and feasibility analysis practices to determine project viability of potential projects is greater than that expected from the review of relevant literature. Differences of opinion and the practical application of techniques have become evident from the analysis of the data. These findings can provide the basis for further rigorous discussion in other forums, backed by the integrity of this survey which can now form part of the body of knowledge and literature concerning property development decision-making and hurdle rate selection practices.

This study analysed and presented findings by examining the literature relating to the property development process, feasibility analysis practices and risk management practices of the industry to provide clear identification of the issues faced by decision-makers in the pre-commitment stages of the development process. Additionally, through the use of an empirical survey and accompanying analysis, these issues were investigated to provide a greater level of clarity on the specific practices used as a basis of determining the viability of potential projects, thereby contributing new perspectives' to the body of knowledge.

Phillips and Pugh (2010, p. 69 – 70), building on the work of Francis (1976), suggest fifteen measures that can be used as an appropriate yardstick as a measure of originality. The following measures outline those that are considered relevant to, as well as those delivered and achieved by, this research:

- Carrying out empirical work not previously undertaken:
    - The survey of decision-makers in property development organisations within Australia which elicited details of their education, experience, motivation, feasibility analysis practices, hurdle rate selection and risk analysis practices. The survey identified opinions on specific aspects regarding the determination of a potential project's viability, including hurdle rate alteration and adaptation in light of a change to risk and uncertainty.

- Making a synthesis not made before:

  - The review of the literature in respect of the property development industry's views (background theory) of the property development process and feasibility analysis practices in comparison to those of the relevant broader property, finance and risk management literature.

- Setting down a major piece of new information in writing for the first time:
  - An original definition of property development was given as follows:

    Property development can be defined as a sequence of steps that take a property development project from inception through to construction and completion including the management of the asset over its lifecycle in order to derive value and achieve the objectives of the project.
  - An identification of a dichotomy between property developers' understanding and the practice of determining project viability.

- Continuation of a previously original piece of work:
  - The extension and updating of the surveys of property development organisations undertaken in the following areas:
    - Concerning hurdle rate selection and use in feasibility analysis practices:
      - Hutchinson *et al*. (2017), Crosby *et al*. (2018), Preller (2009), and Preller and Costello (2010) and Coleman *et al*. (2012).
    - Concerning the risk analysis in feasibility analysis:
      - Wiegelmann (2012), Newell & Steglick (2006), Lyons and Skitmore (2004) and Uher and Toakley (1999).

- Undertaking original research in Australia, which previously, has only been found in other countries:
    - The investigation into heuristic bias and bounded rationality through the use of rules of thumb for hurdle rate selection and usage by Australian and New Zealand property development organisations in the pre-commitment stages of the property development process.
    - The investigation of the methods used to adjust and adapt specific hurdle rate metrics in light of a change in uncertainty and risk in a potential project.

- Generating findings concerning aspects of the property development process not previously reported in the literature:
    - This study was the first to examine the alteration and the adjustment of hurdle rate metrics in the decision-making of Australian and New Zealand property development organisations specifically this in the pre-commitment, site acquisition and due-diligence, stages of the development process.

This section has outlined the key areas where this research has made a contribution to the body of knowledge concerning the process of determining the financial viability of potential projects in the pre-commitment stages of the development process in the Australian and New Zealand property development industry. The following section outlines areas of further research which have been identified as an outcome of the process of undertaking this study.

7.5 Further Research

Chapter 7 has thus far described the purpose and aims of this study which was primarily concerned with making a contribution to the body of knowledge in the areas of site acquisition and determining potential project viability in the pre-commitment stages of the development process. Although not detracting from the contribution of this research, there are several unresolved questions which would make interesting topics of further research which are now discussed.

- The results of the analysis demonstrate that respondent development organisations did not differ in their use of go/no-go hurdle rates, the usage or specific levels of key hurdle rates, the number of hurdle rates used or in the number of variables forecasted to aid in decision-making. These results were different from that which was anticipated and is an area to be considered for further research.

- It was found that the same heuristic bias can be found across industry property types, developer typologies and differing ownership structures and project sizes. It would be beneficial to conduct further research into small to medium size development organisations' decision-making practices and, in particular, should these organisations use different metrics in project selection than those currently adopted when undertaking larger projects?

- The survey results indicated a very low level of adoption and use of sophisticated quantitative techniques including Monte Carlo simulation, probability analysis, qualitative risk matrix and real option theory. Hutchinson *et al.* (2017, p.10) also found very low levels of use of sophisticated decision-making models for property investors and developers in the UK and offered a number of reasons as an explanation. These include the perceived difficulty in applying models to heterogeneous assets, senior management reluctance to accept new approaches and gaps in the knowledge and human capital required to incorporate sophisticated modelling techniques. These explanations may also be relevant to the Australian and New Zealand property development industries and is an area which warrants further research.

- The linking of decision-making practices and hurdle rate selection with project outcomes and developer success ratings is an area that also warrants further research. This could be achieved by the creation of a database of project viability studies from property development organisations which could then be linked to the project's ultimate success under varying market conditions. Although not required for this study, the analysis of this information would allow a deeper understanding of a number of aspects which have had to be inferred from the responses from survey participants. Property development organisations across a number of granulating categories such as property type, tenure, geographic location and ownership structures have provided empirical evidence of their decision-making practices and how they respond to a given change in the perceived uncertainty and risk in the market in which they operate. The inclusion of a set of market conditions and an ultimate outcome for a project could lead to a more detailed decision-making model and/or recommendation of analytical methods for decision-making other than those currently available in the literature.

- The creation of project outcomes and the addition of development project outcomes may also lead to an explanation of why sophisticated analytical methods from the academic literature are not currently being readily adopted by industry. Additionally, material and responses from other research studies and professional bodies, especially from the UK and USA, could form the basis for a comparative study of other geographic regions as well from other industries such as infrastructure projects and long-term property investing.

- The inclusion of project outcome information could also allow for a greater understanding of policy outcomes that interject into the broader property market and upon the property development industry which forms a significant contributor to both GDP and employment in an urbanised economy. The movement of the levers of monetary policy, prudential regulation, the credit cycle and also property taxation at all levels of government, including funding models for public infrastructure levied on property developers, all have a significant impact on the input variables that form critical success factors for property development projects. Greater awareness of the project outcomes following changes in key policy may lead to a better understanding of the outcomes of policy change on the development industry and the economy as a whole.

In conclusion, this study has been successful in achieving its primary aim of investigating the techniques that are being incorporated into the decision-making process during the pre-commitment stage of the development process and how property development organisations adjust their decision-making processes in the light of a predicted change in project uncertainty and risk. Firstly, this study has provided clarification of the types of hurdle rates and decision-making processes used by Australian property developers in order to make a go/no-go project decision. Secondly, this study has provided a more detailed view of the decision-making practices of property developers from a more granulated and stratified perspective across the industry in Australia, greater than and more detailed than any which previously existed. Thirdly, this study has raised further questions concerning the incorporation of hurdle rate selection and determining the viability of property development projects in Australia for subsequent study.

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Appendices A - J

Appendix A - Definitions and Terms

Definitions and Terms

Artificial Neural Networks or ANN's are based on the biological networks that exist within the human brain and were introduced by Mculloch and Pitts (1943). ANNs were later shown to have been a useful technique for testing the relationship between independent variables (Lippmann, 1987, Demyanyk & Hasan, 2010).

Bounded rationality - The constraints to rational decision-making which include (1) lack of information, (b) time constraints and (c) the cognitive abilities of the decision-maker. Other factors that may impair rational decision-making include poor advice, cultural and peer group influences, limited understanding of the issues through poor education or training, cultural and organisational value systems and emotional states (Regan, 2015, p. 2).

Capital Asset Pricing Model - CAPM builds upon modern portfolio theory developed by Markowitz (1959) and aims to discount future cash flows by a minimum market return and a risk-premium commensurate with the expected volatility of returns.

*Code assessment – an assessment that must be carried out only against the assessment benchmarks in a categorising instrument for the development; and having regard to any matters prescribed by regulation. (*Planning Act QLD, 2016, p. 56).

Coombs' Theory - postulates that individuals have an ideal risk level and that choosing between equal probability events, the individual selects the event that is closer to the ideal risk level (Coombs, 1964).

Decision theory is the 'study of how people model 'judgement' and, from that, how they determine their choice' (Atherton *et al*., 2008, p. 164).

Descriptive analysis: models which purport to describe how we do decide. Descriptive models do not seek to aid people in making 'rational' decision Atherton *et al*. (2008, p. 165).

Development value - The estimated value of a property development scheme once completed (adapted from Crosby *et al*., 2018a, p. 4)

A *discount rate* is a required rate of return on a real estate investment/development based on its risk when compared with returns earned on competing investments and other capital market benchmarks (Rowland, 2010).

Discounting is the process of determining the present value (PV) of a cashflow inflows and outflows by taking into account the time value of money of future value (FV) inputs (Moorhead & Armitage, 2019)

Due diligence- a period of time where a contract is not unconditional to allow for the purchaser to review the feasibility of the potential project and acquisition. In terms of property development a due diligence period is equivalent to a call option over real property to evaluate the viability of a potential project.

Factor analysis targets the 'dimensionality of the original space and to give an interpretation to the new space, spanned by a reduced number of new dimensions which are supposed to underlie the old ones' (Rietveld & Van Hout, 1993, p. 254).

Feasibility analysis- Determination of a potential development scheme's forecasted profit or loss in order to determine project viability, the impact of a range of variations on a project, to test the veracity of the assumptions, as a measurement of risk, and as a tool for raising capital in both debt and equity forms (Havard, 2014, p. 12).

Gross realisation (GR) or gross development value (GDV) – is the development value of a completed project after subtracting GST.

Highest and best use (HABU) - the use that represents the greatest economic financial value (Messner, 1977). The Dictionary of Real Estate Appraisal defines highest and best use for a site as the reasonably probable and legal use that generates the highest value (Appraisal Institute (US), 2002, p. 171). process of scheme evaluation will result in a range of values, and the vendor will usually sell to the highest bid that a prospective developer can make while still achieving their target return (Havard, 2014).

Homogenous sampling involves studying individuals who have membership in a subgroup with distinctive characteristics (Patton, 2005; Teddlie & Yu, 2007).

Hurdle rate- A required rate of return or an economic profit that a potential project would need to generate for the property developer to be willing to proceed. From a property investment decision, 'hurdle rates' are linked to capitalisation rates and investment yields in capital budgeting decisions, or a required return less the forecasted long-term growth in income after allowing for depreciation. (Hutchison *et al*., 2017, p. 3)

Impact Assessment - is an assessment that must be carried out against the assessment benchmarks in a categorising instrument for the development; and having regard to any matters prescribed by regulation may be carried out against, or having regard to, any other relevant matter, other than a person's personal circumstances, financial or otherwise (Planning Act QLD, 2016, p. 56).

Kruskal-Wallis Test is the non-parametric alternative to a one-way ANOVA between groups, and also allows for comparison of scores on continuous variables across three or more groups (Pallant, 2011).

Limitation - a 'systematic bias that the researcher did not or could not control and which could inappropriately affect the results' (Price & Murnan, 2004, p. 65).

Mann-Whitney U Test is useful for examining the differences between two independent groups on a continuous measure and is the 'non-parametric alternative to the t-test for independent samples' (Pallant, 2016, p. 227).

Material Change of Use (MCU) - The start of a new use of the premises; (or) the re-establishment of the premises of a use that has been abandoned; (or) a material increase in the intensity or scale of the use of the premises. Planning Act (Qld) 2016, p. 298.

Marketability analysis - can be described as a process where the analyst 'investigates how a particular piece of property will be absorbed, sold, or leased under current or anticipated market conditions' (Reed, 2015, p. 128).

Mixed-methods research involves the use of strands which represents those components of the study that encompasses the basic process of conducting quantitative or qualitative research: posing a question, collecting data, analysing data, and interpreting results based on that data (Teddlie & Tashakkori, 2009).

Monte-Carlo simulation stochastic simulations -are a methodology by which the uncertainty encompassing the main variables projected in a forecasting model is processed in order to estimate the impact of risk on the projected results. (Savvides, 1994, p. 4)

Net Present Value (NPV)– The NPV of a project is the estimated present value of future cash flows minus the present value of the investment made to have the right to receive the future cash flows (Ross *et al*., 2014).

Non-parametric techniques – analyse differences between groups, and differ from parametric techniques in that they do not place the same demands for the distribution of the data but do have the requirements of random samples and independent observations. This technique is useful when data is measured in nominal and ordinal ranked scales as well as categorical variables (Pallant, 2011).

Normative analysis - models which suggest how we should decide. 'Usually based on mathematical axioms, which define rational behaviour'. 'The decision-maker believes A and b then should do X and Y. However, the additional element that is critical in the development process is time'. (Atherton & French, 1997, p. 136; Bell *et al*., 1988)

Pearson Chi-square test – is a non-parametric test of independence that is 'used when you wish to explore the relationship between two categorical variables' (Pallant, 2011, p 217)

Prescriptive analysis - models which use normative models to guide the decision-maker within other limiting cognitive parameters (Atherton *et al*., 2008, p. 165).

Project viability - refers to the outcome of a feasibility analysis forecasting whether a potential development project is anticipated to meet or exceed the required hurdle rates, and therefore, warrants further investigation (Havard, 2014).

Property - is a generic term referring to real assets including land and its improvements rather than the stricter legal definition of a model of rights associated with some tangible and intangible object.

Property development –is a sequence of steps that take a property development project from inception through to construction and completion including the management of the asset over its lifecycle in order to derive value and achieve the projects objectives.

Prospect Theory - risk is regarded as a property of options or events which can be meaningfully ordered for riskiness. The risk of an event is related to the variance of its outcomes (Pollatsek & Tversky, 1970, p. 541).

Purposeful sampling in quantitative and qualitative research means that 'researchers intentionally select participants who have experienced the central phenomenon or key concept being explored in the study' (Creswell & Clark, 2007, p. 173).

Pearson Chi-square test of independence is 'used when you wish to explore the relationship between two categorical variables; (Pallant, 2011, p 217).

Parametric tests are designed to make an 'assumption about the population from which the sample has been drawn' (Pallant, 2011, p 213).

Reliability, is 'the degree to which the instrumentation consistently measures a variable in repeated over multiple periods' (Roberts, 2010, p. 152).

Validity is the degree to which your instrument accurately measures the variables that were intended to be measured. (Roberts, 2010, p. 152).

Confirmatory Factor Analysis (CFA) is a type of factor analysis statistical technique that is used to confirm or reject the null-hypothesis (Child, 2006).

Exploratory Factor Analysis (EFA) is a type of factor analysis statistical technique that is primarily used to uncover complex data patterns by testing predictions (Child, 2006).

Reliability – 'the degree to which the instrumentation consistently measures a variable in repeated over multiple periods' (Roberts, 2010, p. 152).

Residual land valuation (RLV)- is the maximum amount that can be paid for the site or bid at auction after the costs associated with acquiring the site are allowed (Havard, 2014, Isaac *et al.*, 2016)

Risk - an occurrence of a future event that may produce an outcome different from what was anticipated (Regan, 2010).

Sampling - the process of selecting a sample from the sampling population which will work to become the basis for estimating or predicting the prevalence of an unknown piece of information, situation or outcome of the larger population. Kumar and Phrommathed (2005, p. 164)

Scenario Analysis- addresses 'what-if' questions. By allowing multiple variables to be changed the analyst is able to address the interdependence of many input variables. Two common forms include what-if scenarios and probability linked scenarios.

Sensitivity Analysis - changing a variable singularly by a set percentage that is often incremental, and determining the impact of this change on the key financial metrics of the project (Havard, 2014, p. 81).

Site acquisition- is the process of identifying, negotiating and obtaining the legal rights of ownership over land, and is also associated with the determination of the viability of a potential property development project.

Target Internal Rate of Return (TIRR) - is a required IRR set by the decision-maker as a minimum hurdle rate to which a project's forecasted return must be equal or greater than, and a TIRR converts an IRR from a measure of expected return to a 'go' or 'no-go' decision criterion. (Author, 2018).

Uncertainty - Events that cannot be predicted. For example, seismic activity in the form of volcanic eruptions and earthquakes. Uncertain events of catastrophic dimension are termed black swans (Regan, 2015, p.5).

Validity is the degree to which your instrument accurately measures the variables that were intended to be measured.

Appendix B - Questionnaire Survey Instrument, Research Explanation Statement and Participant Consent

BOND UNIVERSITY
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CRICOS CODE 00017B

FEASIBILITY ANALYSIS IN THE PRE-COMMITMENT STAGES OF THE DEVELOPMENT PROCESS
BUHREC No 15151

RE: RESEARCH EXPLANATORY STATEMENT

I would like to introduce myself: my name is Matthew Moorhead and I am conducting research for a PhD under the supervision of Prof Michael Regan and Dr Lynne Armitage. We are pleased to present you with the questionnaire *"Feasibility analysis in the pre-commitment stages of the development process"*. This questionnaire forms an essential part of my Ph.D. thesis with the objective of gaining a greater understanding of the decision making processes currently being used by property development organisations in deciding whether to proceed with site acquisition and/or commencement of a project.In order to accomplish the research aims, a necessary step is to gather empirical evidence of the current practices used within the major property sectors and company types within the Australian property development industry. This questionnaire will be useful to draw comparisons between the theoretical models and processes and actual industry practice.
The questionnaire consists of approximately 25 questions (dependent upon responses) and will take approximately 15 minutes or less. Most questions can be answered by marking the appropriate pre-set answer boxes with a cross. It would be helpful to provide additional comments where you consider this necessary to explain further. In order to make a consistent and representative evaluation, the researcher would be grateful for responses to all questions. In order to accomplish the research aims, a necessary step is to gather empirical evidence of the current practices used within the major property sector and organisations in the Australian property development industry. This questionnaire will be useful to draw comparisons between the theoretical models and processes and actual industry practice.

All data obtained from participants will be kept confidential and will be reported in an aggregate format (by reporting only combined results and never reporting individual ones). All questionnaires will be concealed, and no one other than the primary investigator and supervising researches will have access to them. The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator. There is no direct compensation, however, participants may elect to leave their details to go into the prize draw for an Apple Ipad Air 2 64 GB. Prize draw to be conducted on March 31st 2016 and the winner to be contacted by email and phone. The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator.

Participation in this research study is completely voluntary. You have the right to withdraw at anytime or refuse to participate entirely without jeopardy. If you desire to withdraw, please close your internet browser and notify the principal investigator at mamoorhe@bond.edu.au so you will not be included in subsequent correspondence. We would be grateful if you could participate in the online survey using the link below before 31st March 2016. If you have any questions regarding this research please do not hesitate to contact us on 5595-2194 or by email at mamoorhe@bond.edu.au, mregan@bond.edu.au or larmitag@bond.edu.au. Thank you very much for your time and contribution which are greatly appreciated.

Survey Link: https://bond.qualtrics.com/SE/?SID=SV_4HhryvJGgy0fO9n

Sincerely,

Matthew Moorhead
Faculty of Society & Design

Should you have any complaints concerning the manner in which this research is being conducted please make contact with –

Bond University Human Research Ethics Committee,
Bond University Office of Research Services.
Bond University, Gold Coast, 4229, Australia
Tel: +61 7 5595 4194   Fax: +61 7 5595 1120   email: ethics@bond.edu.au

Appendix B - Questionnaire Survey Instrument, Research Explanation Statement and Participant Consent

FEASIBILITY ANALYSIS IN THE PRE-COMMITMENT STAGES OF THE DEVELOPMENT PROCESS
BUHREC No 15151
BOND UNIVERSITY FACULTY OF SOCIETY AND DESIGN

This survey can be completed via a mobile or on a PC but some responses may require textual answers.

Introduction

I would like to introduce myself: my name is Matthew Moorhead and I am conducting research for a PhD under the supervision of Prof Michael Regan and Dr Lynne Armitage. We are pleased to present you with the questionnaire *"Feasibility analysis in the pre-commitment stages of the development process"*. This questionnaire forms an essential part of my Ph.D. thesis with the objective of gaining a greater understanding of the decision making processes currently being used by property development organisations in deciding whether to proceed with site acquisition and/or commencement of a project.

Procedures

The questionnaire consists of approximately 25 questions (dependent upon responses) and will take approximately 15 minutes or less. Most questions can be answered by marking the appropriate pre-set answer boxes with a cross. It would be helpful to provide additional comments where you consider this necessary to explain further. In order to make a consistent and representative evaluation, the researcher would be grateful for responses to all questions. In order to accomplish the research aims, a necessary step is to gather empirical evidence of the current practices used within the major property sector and organisations in the Australian property development industry. This questionnaire will be useful to draw comparisons between the theoretical models and processes and actual industry practice.

Benefits

There are no direct benefits for participants. However, it is hoped that through your participation, researchers will gain a greater understanding of the decision making processes currently being used by property development organisations.

Confidentiality

All data obtained from participants will be kept confidential and will be reported in an aggregate format (by reporting only combined results and never reporting individual ones). All questionnaires will be concealed, and no one other than the primary investigator and supervising researches will have access to them. The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator.

Compensation

There is no direct compensation, however, participants may elect to leave their details to go into the prize draw for an Apple Ipad Air 2 64 GB. Prize draw to be conducted on March 31st 2016 and the winner to be contacted by email and phone. The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator.

Participation

Participation in this research study is completely voluntary. You have the right to withdraw at anytime or refuse to participate entirely without jeopardy. If you desire to withdraw, please close your internet browser and notify the principal investigator at mamoorhe@bond.edu.au so you will not be included in subsequent correspondence.

Questions about the Research

If you have any questions regarding this research please do not hesitate to contact us on (07) 5595-2194 or by email at mamoorhe@bond.edu.au, mregan@bond.edu.au or larmitag@bond.edu.au. Thank you very much for your time and contribution which are greatly appreciated.

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Appendix B - Questionnaire Survey Instrument, Research Explanation Statement and Participant Consent

Q1.
I have read, understood the above consent form and desire of my own free will to participate in this study.

- ◯ Yes
- ◯ No

Q2. Within the organisation you work for, are you involved in the design, preparation or utilisation of feasibility reports, development appraisals, site valuation or the decision making processes in relation to your firm's or clients property development projects?

- ◯ Yes
- ◯ No

Q3. In which country/s do you conduct property development projects.

- ☐ Australia
- ☐ New Zealand
- ☐ Other Countries

Q4. I wish to be included into the prize draw for an Apple Ipad Air 2 64GB to be drawn on the 31st March 2016.

- ◯ Yes
- ◯ No

Contact details for prize draw:
(Please note: only survey participants who complete and submit the survey including their completed contact details will be eligible for the prize draw.)

Full Name	
Phone Number	
Email Address	

Q5.
Developer Category: Which of the following best describes your company's business activities?

- ◯ Trader Developer (Development of product to on-sell)
- ◯ Investor Developer (Development to retain ownership)
- ◯ Development Management (Development on behalf of a client)
- ◯ Valuation Firm
- ◯ Other (please specify)

Q6. Please provide details on the ownership structure of your organisation.

- ◯ Publicly Traded Company on the ASX (or international exchange)
- ◯ Public Company (Unlisted)
- ◯ Private Company
- ◯ Other (please specify)

Q7.

Distribution Percentage. Please provide the property type distribution percentage based on monetary value of your organisation's property development projects?

	Property Type				
	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Residential	☐	☐	☐	☐	☐
Commercial Office	☐	☐	☐	☐	☐
Retail	☐	☐	☐	☐	☐
Industrial	☐	☐	☐	☐	☐
Tourism	☐	☐	☐	☐	☐
Mixed Use	☐	☐	☐	☐	☐
Other (please specify in the next question)	☐	☐	☐	☐	☐

Q8. If you selected other in the distribution percentage above. Please describe the type of development projects your company undertakes and the % of your total development activity that falls within this description.

Q9. Please indicate your role within your company or organisation.

- ☐ Senior Management (Board, CEO, General Manager)
- ☐ Management (Senior Development Manager, Regional Manager)
- ☐ Operational management (DM, ADM, Project Manager)
- ☐ Sole Trader
- ☐ Other (please specify)

Q10.
Distribution Percentage. Please provide the property type distribution percentage based on monetary value of your organisation's property development projects?

(If known)

Geographic Region	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Queensland	☐	☐	☐	☐	☐
New South Wales	☐	☐	☐	☐	☐
Victoria	☐	☐	☐	☐	☐
Western Australia	☐	☐	☐	☐	☐
Australian Capital Territory	☐	☐	☐	☐	☐
South Australia	☐	☐	☐	☐	☐
Tasmania	☐	☐	☐	☐	☐
Northern Territory	☐	☐	☐	☐	☐
International	☐	☐	☐	☐	☐

Q11.

Please indicate the approximate project size your company prefers to undertake.

Preferred Project Size ($ Revenue)	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
$ 0 – $ 2 million	☐	☐	☐	☐	☐
$ 2 - $ 5 million	☐	☐	☐	☐	☐
$ 5 - $ 10 million	☐	☐	☐	☐	☐
$ 10 - $ 50 million	☐	☐	☐	☐	☐
$ 50 - $ 100 million	☐	☐	☐	☐	☐
+ $100 million	☐	☐	☐	☐	☐
Other (please specify in next question)	☐	☐	☐	☐	☐

Q12. Please indicate your level of experience in the decision making process where you are involved in determining to proceed or not proceed with potential property development projects.

◯ 1 - 2 years

◯ 2 - 5 years

◯ 5 - 10 years

◯ 10 + years

Q13. What is the highest level of education you have completed?

- ○ Less than High School
- ○ High School / Or Equivalent
- ○ Diploma or Trade Certificate
- ○ University Bachelor Degree
- ○ Post Graduate Diploma
- ○ Masters Degree
- ○ Professional Degree (JD, MD)
- ○ Doctoral Degree

Q14. Were any of your qualifications in a property specific related course? (Example, Bachelor of Property or a professional discipline. Eg. Quantity Surveying)

- ○ Yes
- ○ No

Q15. Is there a specialised board, senior management or committee that must approve the decision to proceed beyond the pre-commitment stages of the development process? (Example, site acquisition)

- ○ Yes
- ○ No

Q16. What is the type of specialised board, senior management or committee that must approve the decision to proceed beyond the pre-commitment stages of the development process? (Example, site acquisition)

- ☐ Company Board Level
- ☐ CEO or General Manager
- ☐ CFO or Financial Controller
- ☐ Senior Development Management
- ☐ Chief Risk Officer or Risk Committee/Board
- ☐ Other (please specify)

Q17. Does your company use a proprietary development feasibility program for decision making in choosing whether to proceed with property development projects? (Example: Estate Master DF)

- ◉ Yes
- ○ No

Q18. Please specify which proprietary development feasibility program/s are used for decision making in whether to proceed with property development projects?

- ☐ Estate Master DF
- ☐ Estate Master IA
- ☐ Argus Developer
- ☐ Argus DCF
- ☐ Feastudy Software
- ☐ Sage Timberline Software
- ☐ Zavanti Pty Ltd Software
- ☐ Manage Places Software
- ☐ Other (please specify)

Q19.
If you answered No for Question 17 above, please specify how feasibility analysis is completed.
(Example, Microsoft Excel)

Q20. Does your company use a specific quantifiable go/no go decision process in order to decide whether to proceed with a development project? This may be pre-set requirements such as fore-casted profitability meeting a return on cost (ROC) of X% for example.

- ○ Yes
- ○ No

Q21.
Does your company incorporate specific fixed financial based hurdle rates as a basis for project decisions?
(Example: IRR, NPV, MDC or ROC)

- ○ Yes
- ○ No

Q22.
Please specify the specific fixed financial based hurdle rates used and a rough guideline of the required financial metric for project decisions your company uses? (Example: IRR, NPV, MDC or ROC) Multiple responses are allowed.

(Please note: this information cannot be used to determine information about any specific company)

	Specific Rate Range (E.g. 15% IRR for Residential)
Return on Cost (ROC) / Margin on Development cost (MDC)	
Internal Rate of Return (IRR)	
Target IRR	
Return on Equity (ROE)	
Net Present Value (NPV)	
Minimum $ profit amount	
Minimum $ project size	
Return on investment (ROI)	
Payback Period (PB)	
Return on Assets (ROA)	
Other (please specify in the next question)	

Q23.
Does your company utilise a specific mechanism for altering financial based hurdle rates in responseto a perceived change in future uncertainty? For example, if your company had a fixed hurdle rate for projects of 15% IRR for residential projects, do you alter this rate on a project by project basis given the project's forecast?

- ○ Yes
- ○ No

Please specify the mechanism used for altering financial based hurdle rates in response to a perceived change in risk.

Q24.
Does your company utilise any of the following land value methods for determining a potential development site's value in the pre-commitment stages?

- ☐ Residual Land Value Method
- ☐ Discounted Cash-flow Method
- ☐ Residual Cash-flow Accumulation Method
- ☐ Other (please specify)

Q25.
Does your company have a risk management strategy that is incorporated into feasibility analysis?

- ◯ Yes, implemented
- ◯ Yes, but needs improvement
- ◯ No, but planned
- ◯ No

Q26.
Has your company's risk management policy changed significantly over the last seven years as a result of the global financial crisis?

- ◯ Yes
- ◯ No

Q27.
Does your company utilise any of the following risk analysis methods for determining feasibility of potential development projects in the pre-commitment stages of the development process?

- ☐ Sensitivity Analysis of single variables
- ☐ Scenario Analysis of multiple variables
- ☐ Probability Analysis \ Bayesian Models
- ☐ Monte Carlo Simulations
- ☐ Real Option Models
- ☐ Qualitative Risk Matrix
- ☐ Other (please specify)

Q28.
In conducting feasibility analysis which categories does your company forecast?

	Type of Variable			
	Never	Occasionally	Very Often	Always
Gross sales $ \ m2	☐	☐	☐	☐
Gross Rent of completed product	☐	☐	☐	☐
Demand Capture / Sales	☐	☐	☐	☐
Demand Capture / Tenancy Market	☐	☐	☐	☐
Rental growth escalation	☐	☐	☐	☐
Vacancy rates	☐	☐	☐	☐
Sales rate escalation	☐	☐	☐	☐
Supply of comparable property for sale	☐	☐	☐	☐
Supply of comparable property available for rent	☐	☐	☐	☐
Product absorption rates	☐	☐	☐	☐
Sales volume of comparable properties (liquidity)	☐	☐	☐	☐
Yield of comparable properties	☐	☐	☐	☐
Capitalisation rates	☐	☐	☐	☐
GDP forecasts	☐	☐	☐	☐
Unemployment forecasts	☐	☐	☐	☐
Interest rates	☐	☐	☐	☐
Market volatility	☐	☐	☐	☐

Q29.
Have the variables forecasted in project feasibility analysis remained constant over the past 5 - 7 years?

Never	Rarely	Sometimes	Most of the Time	Always
○	○	○	○	○

Q30.
Do you retrospectively check your forecasts?

Never	Rarely	Sometimes	Most of the Time	Always
○	○	○	○	○

Q31.
In your opinion, does the company you work for regard itself as having a risk taking or risk-averse culture compared to its relevant competitors?

More risk taking	Risk similar to competitors	More risk-averse
○	○	○

Q32.
Please evaluate the following aspects/features of your project decision making process.

	Strongly Disagree	Disagree	Agree	Strongly Agree
There is a consistent decision making methodology applied throughout the company.	☐	☐	☐	☐
The company finds it difficult to identify the main risks for specific projects.	☐	☐	☐	☐
The company finds it difficult to identify the likelihood of risks occurring	☐	☐	☐	☐
The company finds it difficult to assess the impacts of risk materialising.	☐	☐	☐	☐
Relies on external advice.	☐	☐	☐	☐

Q33.
Please evaluate the following aspects/features of your risk management process at the pre-commitment stage of the project development process.

	Yes	Yes, but needs improvement	No	Do not know
The company's structure supports effective risk management	☐	☐	☐	☐
The company's culture supports effective risk management	☐	☐	☐	☐
Reporting and communication processes between staff and top management support the effective management of risk	☐	☐	☐	☐
Roles, responsibilities and accountabilities have been clearly defined	☐	☐	☐	☐
There are clear and written management statements on risk management	☐	☐	☐	☐
The company's senior management is receptive to all communications about risks, including bad news	☐	☐	☐	☐
There is adequate risk management training provided to management and other personnel in order to ensure that adequate capabilities exist within the business	☐	☐	☐	☐
Are the responsibilities for risk management of the project and continuous monitoring of risk been defined?	☐	☐	☐	☐
A functional reporting concept has been designed and fully implemented	☐	☐	☐	☐

Q34.
How confident are you that your company is identifying and preparing for potentially significant risks in potential projects at the pre-commitment stage of the development process?

No confidence	More or less confident	Confident	Absolute Confidence
○	○	○	○

We thank you for your time spent taking this survey.
Your response has been recorded.

Appendix C – Ethics Clearance

The empirical research that forms the basis for the outcomes of this thesis received ethics approval from the Human Research Ethics Committee at Bond University. Ethics approval ID numbers 15151 & 15754.

Appendix C – Ethics Clearance

BOND UNIVERSITY
BRINGING AMBITION TO LIFE

HUMAN RESEARCH ETHICS COMMITTEE
Bond University
Gold Coast, Queensland 4229
Australia
Ph: +61 7 5595 4194
Fax: +61 7 5595 1528
(from overseas)
Email: ethics@bond.edu.au
ABN 88 010 694 121
CRICOS CODE 00017B

23 September 2015

Lynne Armitage, Matthew Moorhead and Michael Regan
Faculty of Society and Design
Bond University

Dear Lynne, Matthew and Michael

Application ID: **15151**
Project Title: **Feasibility Analysis in the Pre-Commitment Stages of the Development Process. An examination of uncertainty, risk and heuristic bias in management decision making processes during the pre-commitment stages of the real estate development process in Austral**

I am pleased to confirm that your project was reviewed by Bond University Human Research Ethics Committee and you have been granted approval to proceed.

The Committee requires, as a condition of approval, that all investigations be carried out in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research* (2007). Approval is subject to conduct of the research in accordance with the requirements set out in the National Statement.

Approval is given subject to the protocol of the study being undertaken as described in your application, and approved amendments. As you may be aware the Ethics Committee is required to annually report on the progress of research it has approved. We would greatly appreciate if you could respond promptly and fully to the request for information on this project which will be distributed in March/April each year.

Under the terms of the National statement BUHREC has a role to monitor approved research projects and if necessary may withdraw approval. Conduct of unapproved research or deviation from the approved protocol may constitute academic misconduct and will be investigated in accordance with Section B of the *Australian Code for the Responsible Conduct of Research* (2007). Please refer to the Research Ethics website for more detail on Research Integrity and Bond University processes for dealing with instances of research misconduct.

You are reminded that the Principal Investigator must immediately report anything that might warrant review of ethical approval of the project. Should you have any queries or experience any problems, please contact us promptly.

We wish you well with your research project.

Yours sincerely

Dr Mark Bahr
Chair Bond University Human Research Ethics Committee

www.bond.edu.au

BOND UNIVERSITY
BRINGING AMBITION TO LIFE

HUMAN RESEARCH ETHICS COMMITTEE
Bond University
Gold Coast, Queensland 4229
Australia
Ph: +61 7 5595 4194
Fax: +61 7 5595 1528
(from overseas)
Email: ethics@bond.edu.au
ABN 88 010 694 121
CRICOS CODE 00017B

19 December 2016

Michael Regan
Faculty of Society and Design
Bond University

Dear Michael

Application ID: **15754**
Project Title: **Feasibility Analysis in the Pre-Commitment Stages of the Development Process. Phase 2 Expert Interviews**
Researchers: **Michael Regan, Matthew Moorhead**

I am pleased to confirm that your project was reviewed by Bond University Human Research Ethics Committee and you have been granted approval to proceed.

The Committee requires, as a condition of approval, that all investigations be carried out in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research* (2007). Approval is subject to conduct of the research in accordance with the requirements set out in the National Statement.

Approval is given subject to the protocol of the study being undertaken as described in your application, and approved amendments. As you may be aware the Ethics Committee is required to annually report on the progress of research it has approved. We would greatly appreciate if you could respond promptly and fully to the request for information on this project which will be distributed in March/April each year.

Under the terms of the National statement BUHREC has a role to monitor approved research projects and if necessary may withdraw approval. Conduct of unapproved research or deviation from the approved protocol may constitute academic misconduct and will be investigated in accordance with Section B of the *Australian Code for the Responsible Conduct of Research* (2007). Please refer to the Research Ethics website for more detail on Research Integrity and Bond University processes for dealing with instances of research misconduct.

You are reminded that the Principal Investigator must immediately report anything that might warrant review of ethical approval of the project. Should you have any queries or experience any problems, please contact us promptly.

We wish you well with your research project.

Yours sincerely

Dr Mark Bahr
Chair Bond University Human Research Ethics Committee

www.bond.edu.au

Appendix D – Decision Tree & Random Forest Results

D-1 - Decision-Tree & Random Forest Analysis Results for having a go/no-go decision making process

Dependent Variable - Q18 – Do you have a go / no-go decision making...
Independent Variable – All other variables

Results of CART Analysis

Error Curve

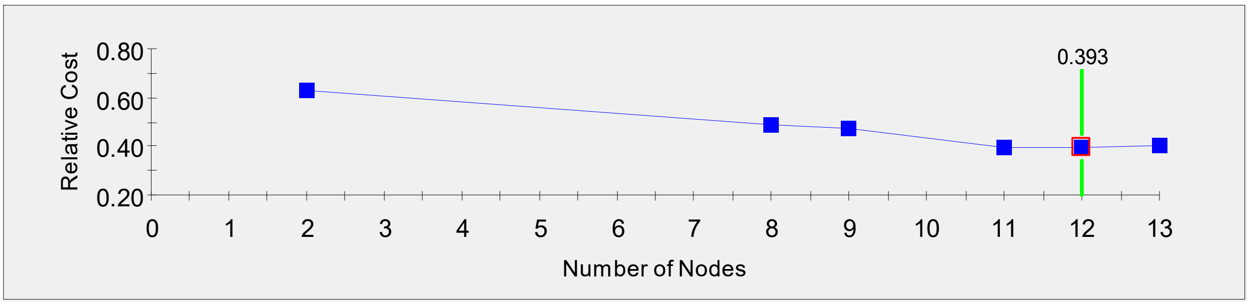


Table 1 – CART Analysis Confusion Matrix – Test

Confusion Matrix - Test

	Actual Class	Total Class	Percent Correct	Predicted Classes	
				No N = 67	Yes N = 121
	No	53	79.25%	42	11

	Yes	135	81.48%	25	110
	Total:	188			
	Average:		80.36%		
	Overall % Correct:		80.85%		
	Specificity		81.48%		
	Sensitivity/Recall		79.25%		
	Precision		62.69%		
	F1 statistic		70.00%		

Table 1 – CART Analysis Variable Importance

Variable Importance

Variable	Score	
Q20_4_2ROEHURDLERATERETURNONEQUITYROE_PERCENT	100.00	
Q20_6_2MINPROFIT_HURDLERATEMINIMUM_PROFIT	71.51	
Q20_11QUALHRINDICATEDAQUALITATIVEHURDLERATEAPPROACH$	56.99	
Q20_2_2IRRHURDLERATEINTERNALRATEOFRETURNIRR_PERCENT	48.17	
Q19HURDLERATEUSEDOESYOURCOMPANYINCORPORATESPECIFICF$	33.51	
Q10DEVSIZEDOMINANTSIZEOFPROJECTIN_ORIFMORETHANONE$	25.82	
Q20_1_2MDCHURDLERATEMARGINONDEVCOSTMDCORROC_PERCENT	17.03	
Q5_DEVELOPER_TYPE$	16.73	
Q9_STATE_DEVELOPMENT_R$	16.38	
Q8_JOB_ROLE_R$	13.22	
Q14_1BOARDOTHER$	12.49	
Q14_1BOARDOTHER_R$	12.49	
Q29FEASOVARCHNGHAVETHEVARIABLESFORECASTEDINPROJECT$	11.79	
Q14DECISIONMAKERISTHEREASPECIALISEDBOARDSENIORMANAG$	10.46	
Q7_PROPERTY_TYPE$	10.06	
Q27_B_NO_OF_RISK_ANALYSIS_METHODS	9.39	
_20_3_2TIRRHURDLERATETARGETIRR_PERCENT	8.95	
Q10BINARYSIZELARGEORSMALL	8.95	
Q27_1SENANALYSISDOESYOURCOMPANYUSESENSITIVITYANALYSISO$	8.70	
HURDLERATENUMNUMBEROFSPECIFICHURDLERATESINDICATED	8.63	
Q24RISKMANPLANDOESYOURCOMPANYHAVEARISKMANAGEMENTST$	7.25	
Q27_7OTHERANALYSISOTHERPLEASESPECIFYASARISKANALYSIS$	5.91	
Q20_1_1MDCDOYOUUSEMDCROCASAHURDLERATE$	5.75	
Q23_2DCFDOESYOURCOMPANYUTILISETHEDISCOUNTEDCASHFLOWM$	5.32	
Q17_4ARGUSDEVDOESYOURCOMPANYUSEARGUSDEVELOPERFEASIBILI$	5.08	
_20_4_1ROEDOYOUUSEROEASHURDLERATE$	4.07	
Q12_EDCUCATION_LEVEL_R$	3.60	
Q6OWNERSHIPPLEASEPROVIDEDETAILSONTHEOWNERSHIPSTRUCTU$	3.38	
Q26_IFYESTORISKPOLICYCHANGE_WHAT$	2.82	
Q11EXPERIENCEPLEASEINDICATEYOURLEVELOFEXPERIENCEINT$	2.76	
Q6_1_ASXPUBLICLISTED	2.61	
Q24RISKMANPLAN_YES_NO_COND$	2.57	
_20_3_1TIRRDOYOUUSETARGETIRRASAHURDLERATE$	1.67	
Q20_5NPVDOYOUUSENPVASAHURDLERATENPVGTTHAN_0$	1.60	
Q30BACKCHECKDOYOURETROSPECTIVELYCHECKYOURFORECASTS$	0.83	

Results of Random Forest with Pruning Analysis

Variable Importance

Variable	Score	
Q20_11QUALHRINDICATEDAQUALITATIVEHURDLERATEAPPROACH$	100.00	|||||||||||||||||||||||||||||||||||||||||
Q19HURDLERATEUSEDOESYOURCOMPANYINCORPORATESPECIFICF$	45.11	||||||||||||||||||
Q7_PROPERTY_TYPE$	44.99	||||||||||||||||||
Q5_DEVELOPER_TYPE$	42.76	|||||||||||||||||
Q9_STATE_DEVELOPMENT_R$	40.79	|||||||||||||||||
Q27_7OTHERANALYSISOTHERPLEASESPECIFYASARISKANALYSIS$	37.31	|||||||||||||||
Q10DEVSIZEDOMINANTSIZEOFPROJECTIN_ORIFMORETHANONE$	34.79	||||||||||||||
Q29FEASOVARCHNGHAVETHEVARIABLESFORECASTEDINPROJECT$	34.29	||||||||||||||
Q21HRALTERDOESYOURCOMPANYUTILISEASPECIFICMECHANISMF$	33.46	|||||||||||||
Q8_JOB_ROLE_R$	26.78	|||||||||||
Q12_EDCUCATION_LEVEL_R$	24.42	||||||||||
Q17_4ARGUSDEVDOESYOURCOMPANYUSEARGUSDEVELOPERFEASIBILI$	22.78	|||||||||
Q26_IFYESTORISKPOLICYCHANGE_WHAT$	22.20	|||||||||
Q6OWNERSHIPPLEASEPROVIDEDETAILSONTHEOWNERSHIPSTRUCTU$	20.23	||||||||
Q11EXPERIENCEPLEASEINDICATEYOURLEVELOFEXPERIENCEINT$	19.92	||||||||
Q25RISKPOLCHNGHASYOURCOMPANYSRISKMANAGEMENTPOLICITY$	17.02	||||||
Q31_RISK_TOLERANCE_SCALE$	16.66	||||||
Q24RISKMANPLANDOESYOURCOMPANYHAVEARISKMANAGEMENTST$	16.53	||||||
Q30BACKCHECKDOYOURETROSPECTIVELYCHECKYOURFORECASTS$	16.29	||||||
Q13PROPERTYQUALWEREANYOFYOURQUALIFICATIONSINAPROPER$	15.61	||||||
Q27_1SENANALYSISDOESYOURCOMPANYUSESENSITIVITYANALYSISO$	15.00	|||||
Q14_1BOARDOROTHER$	14.05	|||||
Q3_2NZDEVDOYOUCONDUCTPROPERTYDEVELOPMENTSINNEWZEALAND$	13.11	|||||
Q20_2_1IRRDOYOUUSEIRRASAHURDLERATE$	11.13	||||
Q23_4MARKCOMPDOESYOURCOMPANYUTILISETHEMARKETCOMPARIS$	9.85	|||
Q17_1EMDFDOESYOURCOMPANYUSEESTATEMASTERDFDEVELOPMENT$	9.54	|||
Q20_2_2IRRHURDLERATEINTERNALRATEOFRETURNIRR_PERCENT	9.52	|||
Q3_1AUSDEVDOYOUCONDUCTPROPERTYDEVELOPMENTSINAUSTRALIA$	9.01	|||
HURDLERATENUMNUMBEROFSPECIFICHURDLERATESINDICATED	8.50	|||
Q14DECISIONMAKERISTHEREASPECIALISEDBOARDSENIORMANAG$	8.22	|||
Q22_3ALTERHRQUALFRAMEALTERSHURDLERATESONQUALITATIVE$	8.22	|||
Q23_2DCFDOESYOURCOMPANYUTILISETHEDISCOUNTEDCASHFLOWM$	6.74	||
Q22_1HRALTERRAALTERSHURDLERATESONRISKANALYSISIEMA$	6.72	||
Q20_1_2MDCHURDLERATEMARGINONDEVCOSTMDCORROC_PERCENT	6.62	||
Q27_B_NO_OF_RISK_ANALYSIS_METHODS	5.96	||
Q16FEASOPROGRAMDOESYOURCOMPANYUSEAPROPRIETARYDEVELOPME$	5.72	|
Q17_2EXCELDOESYOURCOMPANYUSEMICROSOFTEXCEL$	5.33	|
Q17_6FEASTUDYDOESYOURCOMPANYUSEFEASTUDYFEASIBILITYPROGR$	4.70	|

Q20_7_1MINPROJDOYOUUSEMINIMUM_PROJECTSIZEASAHURDLE$	4.50	
Q10BINARYSIZELARGEORSMALL	4.33	
Q23_1RLVDOESYOURCOMPANYUTILISETHERESIDUALLANDVALUEM$	4.19	
_20_3_1TIRRDOYOUUSETARGETIRRASAHURDLERATE$	4.04	
Q27_3MCANALYSISMONTECARLOSIMULATIONSASARISKANALYSISM$	3.96	
Q20_5NPVDOYOUUSENPVASAHURDLERATENPVGTTHAN_0$	3.92	
Q24RISKMANPLAN_YES_NO_COND$	3.74	
Q27_6ROANALYSISREALOPTIONMODELSASARISKANALYSISMETHOD$	3.39	
Q23_3RESACCFLOWDOESYOURCOMPANYUTILISETHERESIDUALACC$	2.70	
Q27_2SCENANALYSISDOESYOURCOMPANYUSESCENARIOANALYSISOF$	0.33	

Confusion Matrix - Test

Actual Class	Total Class	Percent Correct	Predicted Classes	
			No N = 16	Yes N = 13
No	4	100.00%	4	0
Yes	25	52.00%	12	13
Total:	29			
Average:		76.00%		
Overall % Correct:		58.62%		
Specificity		52.00%		
Sensitivity/Recall		100.00%		
Precision		25.00%		
F1 statistic		40.00%		

Results of TREENET Analysis

Confusion Matrix - OOB

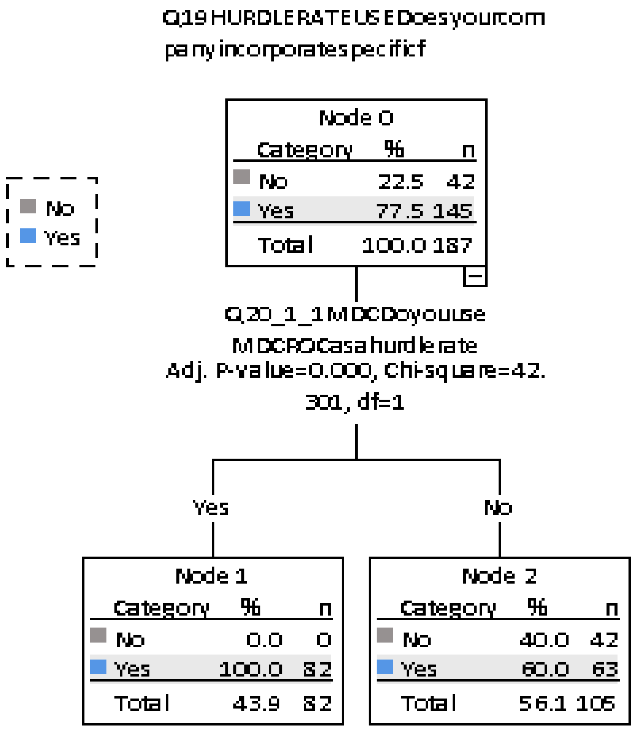
Actual Class	Total Class	Percent Correct	Predicted Classes	
			No N = 156	Yes N = 32
No	53	92.45%	49	4
Yes	135	20.74%	107	28
Total:	188			
Average:		56.60%		
Overall % Correct:		40.96%		
Specificity		20.74%		
Sensitivity/Recall		92.45%		
Precision		31.41%		
F1 statistic		46.89%		

Variable Importance

Variable	Score
Q20_11QUALHRINDICATEDAQUALITATIVEHURDLERATEAPPROACH$	15.32
Q19HURDLERATEUSEDOESYOURCOMPANYINCORPORATESPECIFICF$	8.74
Q20_1_1MDCDOYOUUSEMDCROCASAHURDLERATE$	5.53
Q9_STATE_DEVELOPMENT_R$	4.03
Q5_DEVELOPER_TYPE$	3.82
Q7_PROPERTY_TYPE$	3.36
_20_3_1TIRRDOYOUUSETARGETIRRASAHURDLERATE$	3.19
Q8_JOB_ROLE_R$	3.13
Q14_1BOARDOROTHER_R$	2.75
Q11EXPERIENCEPLEASEINDICATEYOURLEVELOFEXPERIENCEINT$	2.66
HURDLERATENUMNUMBEROFSPECIFICHURDLERATESINDICATED	2.52
Q10DEVSIZEDOMINANTSIZEOFPROJECTIN_ORIFMORETHANONE$	2.47
Q26_IFYESTORISKPOLICYCHANGE_WHAT$	2.36
Q20_2_1IRRDOYOUUSEIRRASAHURDLERATE$	2.10
Q24RISKMANPLANDOESYOURCOMPANYHAVEARISKMANAGEMENTST$	2.10
Q14_1BOARDOROTHER$	1.87
Q21HRALTERDOESYOURCOMPANYUTILISEASPECIFICMECHANISMF$	1.86
Q12_EDCUCATION_LEVEL_R$	1.85
Q31_RISK_TOLERANCE_SCALE$	1.84
Q30BACKCHECKDOYOURETROSPECTIVELYCHECKYOURFORECASTS$	1.58
Q27_2SCENANALYSISDOESYOURCOMPANYUSESCENARIOANALYSISOF$	1.56
Q6OWNERSHIPPLEASEPROVIDEDETAILSONTHEOWNERSHIPSTRUCTU$	1.53
Q29FEASOVARCHNGHAVETHEVARIABLESFORECASTEDINPROJECT$	1.41
Q20_5NPVDOYOUUSENPVASAHURDLERATENPVGTTHAN_0$	1.30
Q22_3ALTERHRQUALFRAMEALTERSHURDLERATESONQUALITATIVE$	1.15
Q22_1HRALTERRAALTERSHURDLERATESONRISKANALYSISIEMA$	1.12
Q27_7OTHERANALYSISOTHERPLEASESPECIFYASARISKANALYSIS$	1.03
Q17_8PROPRIETARYPROGRAMDIDYOURCOMPANYHAVEITSOWNPROGRAM$	1.02
Q27_3MCANALYSISMONTECARLOSIMULATIONSASARISKANALYSISM$	0.81
_20_4_1ROEDOYOUUSEROEASHURDLERATE$	0.78
Q23_1RLVDOESYOURCOMPANYUTILISETHERESIDUALLANDVALUEM$	0.77
Q20_8_1ROIDOYOUUSEROIASAHURDLERATE$	0.77
Q20_2_2IRRHURDLERATEINTERNALRATEOFRETURNIRR_PERCENT	0.75
Q20_1_2MDCHURDLERATEMARGINONDEVCOSTMDCORROC_PERCENT	0.74
Q20_7_1MINPROJDOYOUUSEMINIMUM_PROJECTSIZEASAHURDLE$	0.74
Q27_B_NO_OF_RISK_ANALYSIS_METHODS	0.72
Q27_1SENANALYSISDOESYOURCOMPANYUSESENSITIVITYANALYSISO$	0.70
Q17_2EXCELDOESYOURCOMPANYUSEMICROSOFTEXCEL$	0.65
_20_3_2TIRRHURDLERATETARGETIRR_PERCENT	0.63
Q17_1EMDFDOESYOURCOMPANYUSEESTATEMASTERDFDEVELOPMENT$	0.61
Q3_2NZDEVDOYOUCONDUCTPROPERTYDEVELOPMENTSINNEWZEALAND$	0.58
Q22_3ALTERHRPLANALTERSHURDLERATESONPLANNINGORGEOGRA$	0.54
Q23_2DCFDOESYOURCOMPANYUTILISETHEDISCOUNTEDCASHFLOWM$	0.52
Q3_1AUSDEVDOYOUCONDUCTPROPERTYDEVELOPMENTSINAUSTRALIA$	0.50
Q23_4MARKCOMPDOESYOURCOMPANYUTILISETHEMARKETCOMPARIS$	0.49
Q14DECISIONMAKERISTHEREASPECIALISEDBOARDSENIORMANAG$	0.48
Q25RISKPOLCHNGHASYOURCOMPANYSRISKMANAGEMENTPOLICITY$	0.44
Q27_5PROPANALYSISPROBABILITYANALYSISBAYESIANMODELSASA$	0.40
Q20_6_1MINPROFITDOYOUUSEMINIMUM_PROFITASAHURDLERAT$	0.38
Q24RISKMANPLAN_YES_NO_COND$	0.36
Q16FEASOPROGRAMDOESYOURCOMPANYUSEAPROPRIETARYDEVELOPME$	0.36
Q27_6ROANALYSISREALOPTIONMODELSASARISKANALYSISMETHOD$	0.35
Q10BINARYSIZELARGEORSMALL	0.34
Q20_4_2ROEHURDLERATERETURNONEQUITYROE_PERCENT	0.34
Q17_4ARGUSDEVDOESYOURCOMPANYUSEARGUSDEVELOPERFEASIBILI$	0.34
Q27_4QUALMATRIXQUALITATIVERISKMATRIXASARISKANALYSISM$	0.29
Q13PROPERTYQUALWEREANYOFYOURQUALIFICATIONSINAPROPER$	0.28
Q17_6FEASTUDYDOESYOURCOMPANYUSEFEASTUDYFEASIBILITYPROGR$	0.26
Q23_3RESACCFLOWDOESYOURCOMPANYUTILISETHERESIDUALACC$	0.26

Q20_9_1PBDOYOUUSEPAYBACKPERIODYEARSASAHURDLERATE$	0.18	
Q6_1_ASXPUBLICLISTED	0.18	
Q20_7_2MINPROJ_HURDLERATEMINIMUM_PROJECTSIZE	0.09	
Q17_5ARGUSDCFDOESYOURCOMPANYUSEARGUSDCFFEASIBILITYPRO$	0.07	
Q20_10_1MORDOYOUUSEMARGINONREVENUEASAHURDLERATE$	0.05	
Q17_7SAGEDOESYOURCOMPANYUSESAGETIMBERLINESOFTWAREFEASI$	0.04	

D-2 - Decision-Tree analysis results for using specific hurdle rates mechanisms



Risk

Estimate	Std. Error
.225	.031

Growing Method: CHAID

Dependent Variable: Q19 Company uses specific hurdle rates

Classification

Observed	Predicted		
	No	Yes	Percent Correct
No	0	42	0.0%
Yes	0	145	100.0%
Overall Percentage	0.0%	100.0%	77.5%

Growing Method: CHAID

Dependent Variable: Q19 Company uses specific hurdle rates

Appendix E - Results of Artificial Neural Network Analysis

E-1: ANN as a predictor of developer type

Multilayer Perceptron

Case Processing Summary

		N	Percent
Sample	Training	104	68.9%
	Testing	47	31.1%
Valid		151	100.0%
Excluded		79	
Total		230	

Model Summary

Training	Cross Entropy Error	107.882
	Percent Incorrect Predictions	50.0%
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:00:00.04
Testing	Cross Entropy Error	42.495
	Percent Incorrect Predictions	36.2%

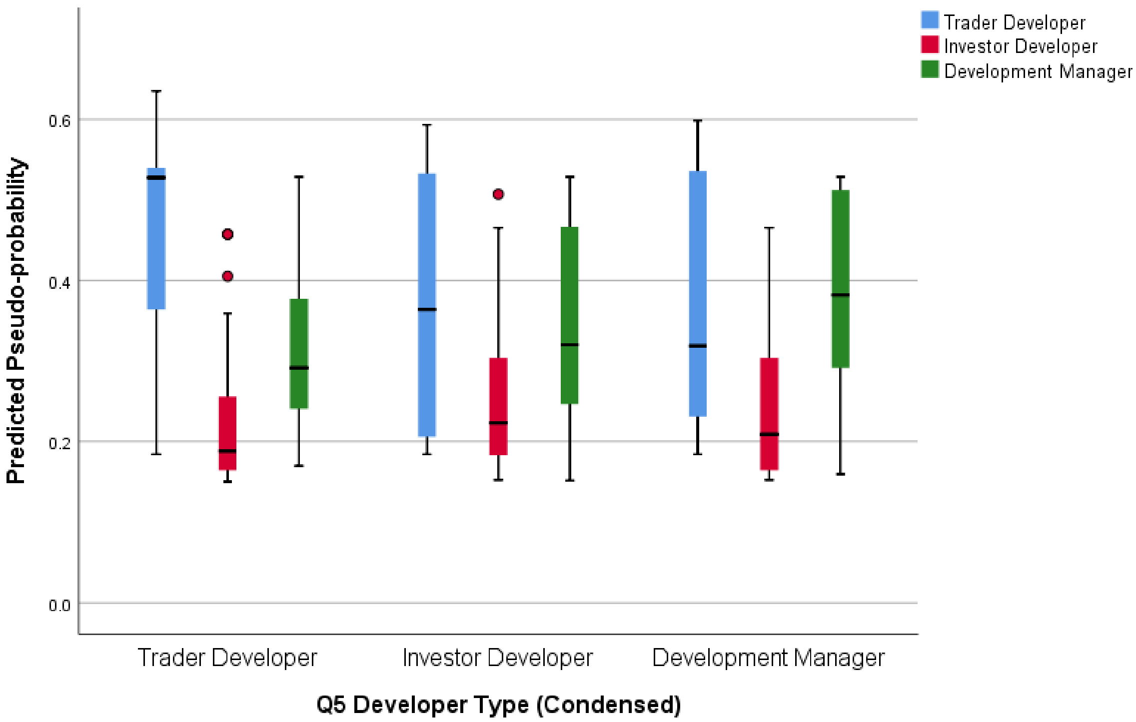
Dependent Variable: Q5 Developer Type (Condensed)

a. Error computations are based on the testing sample.

Classification

Sample	Observed	Predicted			
		Trader Developer	Investor Developer	Development Manager	Percent Correct
Training	Trader Developer	30	2	15	63.8%
	Investor Developer	11	7	9	25.9%
	Development Manager	9	6	15	50.0%
	Overall Percent	48.1%	14.4%	37.5%	50.0%
Testing	Trader Developer	20	1	2	87.0%
	Investor Developer	3	0	1	0.0%
	Development Manager	8	2	10	50.0%
	Overall Percent	66.0%	6.4%	27.7%	63.8%

Dependent Variable: Q5 Developer Type (Condensed)


Trader Developer
Investor Developer
Development Manager
Predicted Pseudo-probability
0.0
0.2
0.4
0.6
Trader Developer
Investor Developer
Development Manager
Q5 Developer Type (Condensed)

E-2: ANN of Property Type and Forecast Variables

Model Summary

Training	Cross Entropy Error	123.830
	Percent Incorrect Predictions	47.7%
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:00:00.04
Testing	Cross Entropy Error	23.808
	Percent Incorrect Predictions	47.1%

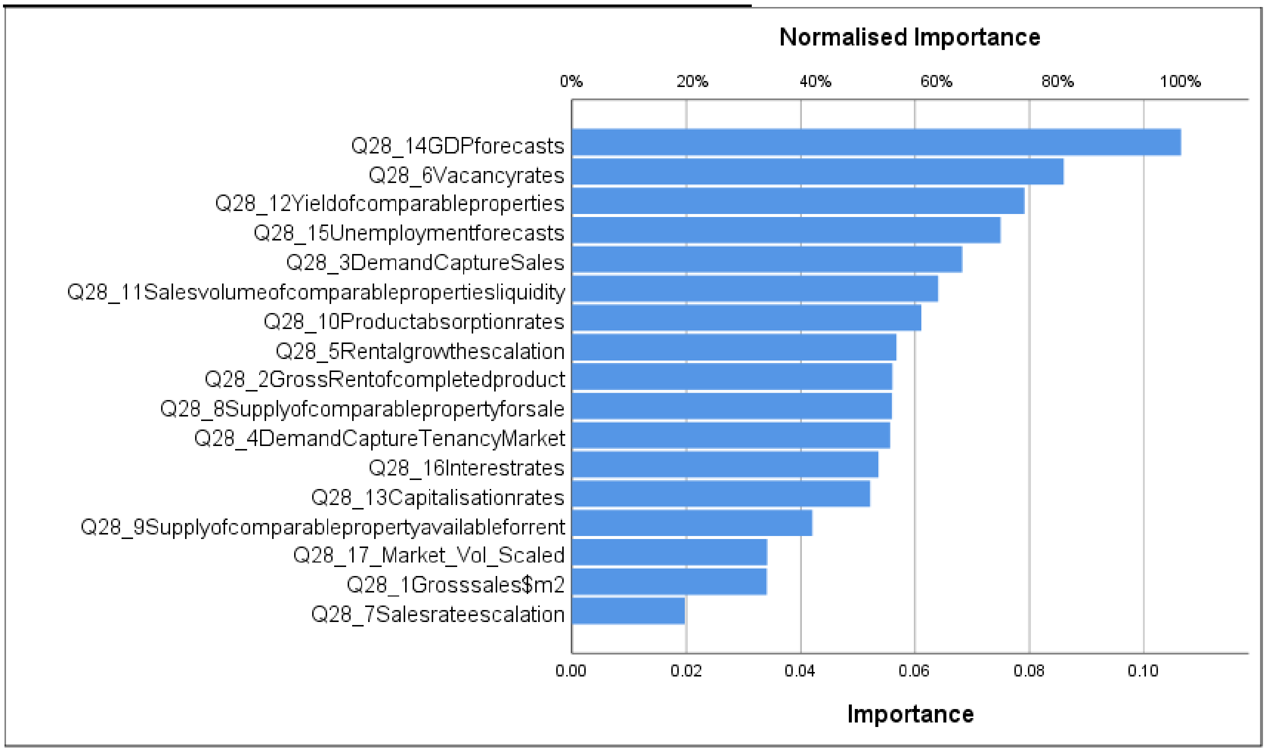
Dependent Variable: Dominant type of property developed

a. Error computations are based on the testing sample.

Independent Variable Importance

	Importance	Normalized Importance
Q28_1Grosssales$m2	.034	31.9%
Q28_2GrossRentofcompletedproduct	.056	52.6%
Q28_3DemandCaptureSales	.068	64.1%
Q28_4DemandCaptureTenancyMarket	.056	52.2%
Q28_5Rentalgrowthescalation	.057	53.2%
Q28_6Vacancyrates	.086	80.7%
Q28_7Salesrateescalation	.020	18.5%
Q28_8Supplyofcomparablepropertyforsale	.056	52.5%
Q28_9Supplyofcomparablepropertyavailableforrent	.042	39.5%
Q28_10Productabsorptionrates	.061	57.3%
Q28_11Salesvolumeofcomparablepropertiesliquidity	.064	60.1%
Q28_12Yieldofcomparableproperties	.079	74.3%
Q28_13Capitalisationrates	.052	48.9%
Q28_14GDPforecasts	.107	100.0%
Q28_15Unemploymentforecasts	.075	70.3%

Q28_16Interestrates	.054	50.3%
Q28_17_Market_Vol_Scaled	.034	32.0%



E-3: ANN of Property Type and Hurdle Rate Selection

Model Summary

Training	Cross Entropy Error	178.089
	Percent Incorrect Predictions	49.6%
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:00:00.04
Testing	Cross Entropy Error	62.072
	Percent Incorrect Predictions	50.0%

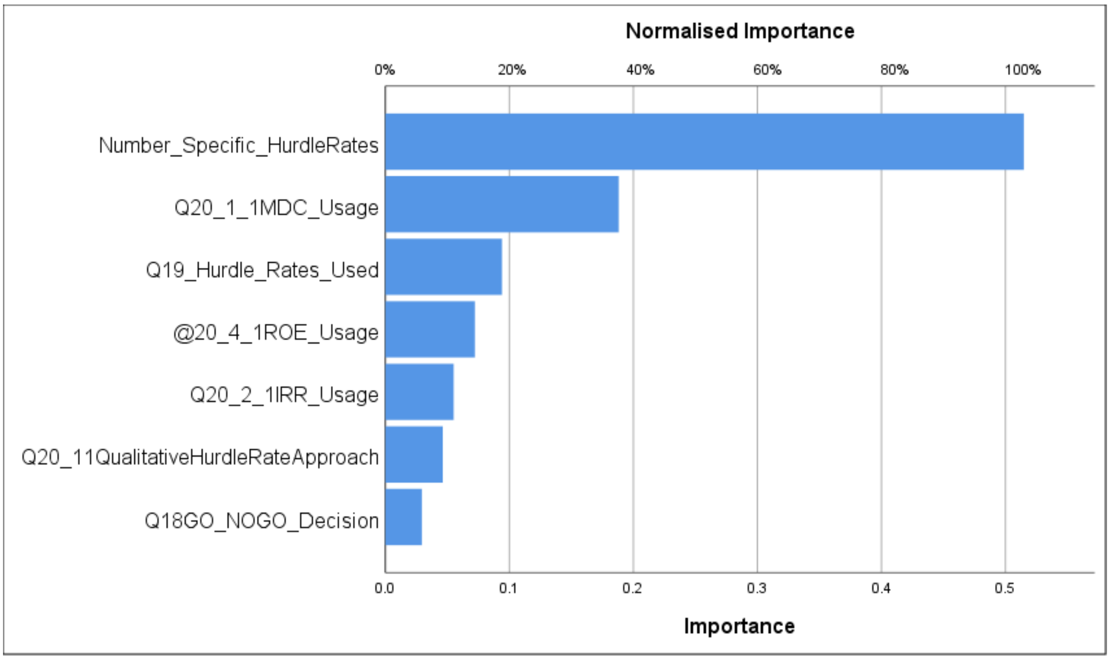
Dependent Variable: Dominant type of property developed condensed

a. Error computations are based on the testing sample.

Classification

		Predicted					
Sample	Observed	Residential	Commercial	Retail	Mixed-Use	Other	Percent Correct
Training	Residential	69	0	0	0	0	100.0%
	Commercial	6	0	1	0	0	0.0%
	Retail	15	0	0	0	0	0.0%
	Mixed-Use	24	0	0	0	0	0.0%
	Other	22	0	0	0	0	0.0%
	Overall Percent	99.3%	0.0%	0.7%	0.0%	0.0%	50.4%
Testing	Residential	25	0	0	0	0	100.0%
	Commercial	1	0	0	0	1	0.0%
	Retail	3	0	0	0	0	0.0%
	Mixed-Use	13	0	0	0	0	0.0%
	Other	7	0	0	0	0	0.0%
	Overall Percent	98.0%	0.0%	0.0%	0.0%	2.0%	50.0%

Dependent Variable: Dominant type of property developed condensed


Normalised Importance
0%
20%
40%
60%
80%
100%
Number_Specific_HurdleRates
Q20_1_1MDC_Usage
Q19_Hurdle_Rates_Used
@20_4_1ROE_Usage
Q20_2_1IRR_Usage
Q20_11QualitativeHurdleRateApproach
Q18GO_NOGO_Decision
0.0
0.1
0.2
0.3
0.4
0.5
Importance

E-4: ANN of Hurdle rate altering and demographic characteristics

Case Processing Summary

		N	Percent
Sample	Training	83	74.1%
	Testing	29	25.9%
Valid		112	100.0%
Excluded		118	
Total		230	

Model Summary

Training	Cross Entropy Error	40.149
	Percent Incorrect Predictions	22.9%
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:00:00.16
Testing	Cross Entropy Error	15.951
	Percent Incorrect Predictions	27.6%

Dependent Variable: Has specific mechanism for altering hurdle rates

a. Error computations are based on the testing sample.

Classification

		Predicted		
Sample	Observed	No	Yes	Percent Correct
Training	No	41	7	85.4%
	Yes	12	23	65.7%
	Overall Percent	63.9%	36.1%	77.1%
Testing	No	15	2	88.2%
	Yes	6	6	50.0%
	Overall Percent	72.4%	27.6%	72.4%

Dependent Variable: Has specific mechanism for altering hurdle rates

Independent Variable Importance

	Importance	Normalized Importance
Q5_Developer_Type	.076	100.0%
Q3_1AUSDEVDoyouconductpropertydevelopmentsinAustralia	.036	47.1%
Q3_2NZDEVDoyouconductpropertydevelopmentsinNewZealand	.039	51.6%
Geography Condensed to Australia New Zealand or Other	.024	32.0%
Ownership Public, Private or Other	.034	45.4%
Dominant type of property developed condensed	.061	80.0%
Q8_Job_Role_R	.044	57.7%
Q9_State_Development_R	.044	57.5%
Q10 Project Size Small, Medium or Large	.027	35.1%
Q11_Experience_Years	.040	53.3%
Q12_Edcucation_Level_R	.059	78.5%
Q13_Property_Qualification	.009	12.0%
Num_Levels_Approve_Proceed	.024	32.1%
Q16 Uses a proprietary feasibility program	.025	32.4%
Q17_1EMDFDoesyourcompanyuseEstateMasterDFdevelopment	.011	14.9%
Q17_2EXCELDoesyourcompanyuseMicrosoftExcel	.046	60.7%
Q17_8PROPRIETARYPROGRAMDidyourcompanyhaveitsownprogram	.013	17.2%
Q18_B_Binary_Consisten_Decision_Methodology	.035	45.8%
Q19 Company uses specific hurdle rates	.021	28.1%
Q20_1_1MDC_Usage	.056	74.4%
Q20_2_1IRR_Usage	.057	75.2%
@20_3_1TIRR_Usage	.036	47.4%
@20_4_1ROE_Usage	.030	40.0%
NPV used	.012	15.9%
Q20_6_1MINPROFIT$_Usage	.021	27.9%
Q20_7_1MINPROJ$_Usage	.013	17.6%
Q20_8_1ROI_Usage	.032	42.4%
Q20_9_1PaybackPeriodYears_Usage	.013	16.6%
Q20_10_1MOR_Usage	.029	38.8%
Q20_11QualitativeHurdleRateApproach	.033	43.8%

Appendix F -Non-Parametric Tests of Independent Samples

F-1: Non-parametric Mann-Whitney U test of 2-independen samples by using Monte Carlo simulations, Real Option theory or probability/Bayesian models in risk analysis with years' experience

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q11_Experience_Years	188	2.56	1.129	1	4
Q27 Uses Monte Carlo, Real Option or Probability/Bayesian	175	.20	.401	0	1

Ranks

	Q27 Uses Monte Carlo, Real Option or Probability/Bayesian	N	Mean Rank	Sum of Ranks
Q11_Experience_Years	No	140	89.81	12574.00
	Yes	35	80.74	2826.00
	Total	175		

Test Statistics[a]

	Q11_Experience_Years
Mann-Whitney U	2196.000
Wilcoxon W	2826.000
Z	-.979
Asymp. Sig. (2-tailed)	.327

a. Grouping Variable: Q27 Uses Monte Carlo, Real Option or Probability/Bayesian

F-2: Non-parametric Mann-Whitney U test of 2-independen samples of trader developer type and MDC and IRR hurdle rate usage

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q20_1_1MDC_Usage	205	.40	.491	0	1
Q20_2_1IRR_Usage	209	.31	.464	0	1
@20_4_1ROE_Usage	205	.10	.304	0	1
Q20_11QualitativeHurdleRateApproach	205	.16	.364	0	1
Q5_1TRADERDEVIsyourcompanyaTraderDeveloper	225	.32	.468	0	1

Ranks

	Q5_1TRADERDEVIsyourcompanyaTraderDeveloper	N	Mean Rank	Sum of Ranks
Q20_1_1MDC_Usage	No	134	94.13	12613.00
	Yes	71	119.75	8502.00
	Total	205		
Q20_2_1IRR_Usage	No	137	99.20	13590.00
	Yes	72	116.04	8355.00
	Total	209		
@20_4_1ROE_Usage	No	134	102.44	13727.50
	Yes	71	104.05	7387.50
	Total	205		
Q20_11QualitativeHurdleRateApproach	No	134	105.36	14118.00
	Yes	71	98.55	6997.00
	Total	205		

Test Statistics[a]

	Q20_1_1MDC_Usage	Q20_2_1IRR_Usage	@20_4_1ROE_Usage	Q20_11QualitativeHurdleRateApproach
Mann-Whitney U	3568.000	4137.000	4682.500	4441.000
Wilcoxon W	12613.000	13590.000	13727.500	6997.000
Z	-3.467	-2.387	-.351	-1.244
Asymp. Sig. (2-tailed)	.001	.017	.726	.214

a. Grouping Variable: Q5_1TRADERDEVIsyourcompanyaTraderDeveloper

F-3: Non-parametric Mann-Whitney U test of 2-independent samples of multinational developer type and MDC and qualitative framework hurdle rate usage

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q20_1_1MDC_Usage	205	.40	.491	0	1
Q20_10_1MOR_Usage	205	.02	.139	0	1
Q20_11QualitativeHurdleRateApproach	205	.16	.364	0	1
Q4_1Multiple_Countires	203	.06	.245	0	1

Ranks

	Q4_1Multiple_Countires	N	Mean Rank	Sum of Ranks
Q20_1_1MDC_Usage	No	190	104.27	19811.50
	Yes	13	68.81	894.50
	Total	203		
Q20_10_1MOR_Usage	No	190	102.14	19406.00
	Yes	13	100.00	1300.00
	Total	203		
Q20_11QualitativeHurdleRateApproach	No	190	100.42	19080.50
	Yes	13	125.04	1625.50
	Total	203		

Test Statistics[a]

	Q20_1_1MDC_Usage	Q20_10_1MOR_Usage	Q20_11QualitativeHurdleRateApproach
Mann-Whitney U	803.500	1209.000	935.500
Wilcoxon W	894.500	1300.000	19080.500
Z	-2.478	-.527	-2.316
Asymp. Sig. (2-tailed)	.013	.598	.021

a. Grouping Variable: Q4_1Multiple_Countires

F-4: Non-parametric Mann-Whitney U test of 2-independen samples of ASX or other listed developer type and MDC, IRR & NPV hurdle rate usage

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q20_1_1MDC_Usage	205	.40	.491	0	1
Q20_2_1IRR_Usage	209	.31	.464	0	1
NPV used	205	.07	.261	0	1
Q6_1 ASX Listed Public	190	.2947	.45713	.00	1.00

Ranks

	Q6_1 ASX Listed Public	N	Mean Rank	Sum of Ranks
Q20_1_1MDC_Usage	No	134	97.54	13070.00
	Yes	56	90.63	5075.00
	Total	190		
Q20_2_1IRR_Usage	No	134	91.15	12214.00
	Yes	56	105.91	5931.00
	Total	190		
NPV used	No	134	96.51	12932.00
	Yes	56	93.09	5213.00
	Total	190		

Test Statistics[a]

	Q20_1_1MDC_Usage	Q20_2_1IRR_Usage	NPV used
Mann-Whitney U	3479.000	3169.000	3617.000
Wilcoxon W	5075.000	12214.000	5213.000
Z	-.922	-2.061	-.836
Asymp. Sig. (2-tailed)	.356	.039	.403

a. Grouping Variable: Q6_1 ASX Listed Public

F-5: Non-parametric Mann-Whitney U test of 2-independen samples by private company structure developer type and MDC, IRR, ROE & NPV hurdle rate usage as well as decision making processes Q18, Q19, Q221 & Q23

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q18_B_Binary_Consisten_Decision_Methodology	170	.81	.392	0	1
Q19 Company uses specific hurdle rates	187	.78	.418	0	1
Q20_1_1MDC_Usage	205	.40	.491	0	1
Q20_2_1IRR_Usage	209	.31	.464	0	1
@20_4_1ROE_Usage	205	.10	.304	0	1
NPV used	205	.07	.261	0	1
Q22_1HRALTERRAAltersHurdleratesonriskanalysisieMa	181	.29	.456	0	1
Q22_3ALTERHRQUALFRAMEAltersHurdleratesonQualitative	181	.09	.285	0	1
Q22_3ALTERHRPLANAltersHurdleratesonPlanningorGeogra	181	.07	.259	0	1
Q23_1RLVDoesyourcompanyutilisetheresiduallandvaluem	178	.74	.439	0	1
Q23_2DCFDoesyourcompanyutilisetheDiscountedCashflowM	179	.49	.501	0	1
Q23_3RESACCFLOWDoesyourcompanyutilisetheResidualAcc	178	.07	.261	0	1
Q23_4MARKCOMPDoesyourcompanyutilisetheMarketComparis	177	.07	.262	0	1
Q6_Private_Company	193	.61	.490	0	1

Ranks

	Q6_Private_Company	N	Mean Rank	Sum of Ranks
Q18_B_Binary_Consisten_Decision_Methodology	0	61	90.35	5511.50
	1	109	82.78	9023.50
	Total	170		
Q19 Company uses specific hurdle rates	0	74	99.84	7388.00
	1	113	90.18	10190.00
	Total	187		
Q20_1_1MDC_Usage	0	76	91.55	6958.00
	1	117	100.54	11763.00
	Total	193		
Q20_2_1IRR_Usage	0	76	105.13	7990.00
	1	117	91.72	10731.00
	Total	193		
@20_4_1ROE_Usage	0	76	90.31	6863.50
	1	117	101.35	11857.50
	Total	193		
NPV used	0	76	95.85	7284.50
	1	117	97.75	11436.50
Q22_1HRALTERRAAltersHurdleratesonriskanalysisieMa	0	70	96.82	6777.50
	1	111	87.33	9693.50
	Total	181		
Q22_3ALTERHRQUALFRAMEAltersHurdleratesonQualitative	0	70	90.76	6353.00
	1	111	91.15	10118.00
Q22_3ALTERHRPLANAltersHurdleratesonPlanningorGeogra	0	70	96.14	6729.50
	1	111	87.76	9741.50
Q23_1RLVDoesyourcompanyutilisetheresiduallandvaluem	0	67	87.72	5877.50
	1	110	89.78	9875.50
Q23_2DCFDoesyourcompanyutilisetheDiscountedCashflowM	0	68	99.16	6743.00
	1	110	83.53	9188.00
Q23_3RESACCFLOWDoesyourcompanyutilisetheResidualAcc	0	67	87.78	5881.50
	1	110	89.74	9871.50
Q23_4MARKCOMPDoesyourcompanyutilisetheMarketComparis	0	67	86.46	5793.00
	1	110	90.55	9960.00

Appendix F -Non-Parametric Tests of Independent Samples

Test Statistics[a]

	Q18_B_Binary_Consisten_Decision_Methodology	Q19 Company uses specific hurdle rates	Q20_1_1MDC_Usage	Q20_2_1IRR_Usage	@20_4_1ROE_Usage	NPV used	Q22_1HRALTERRAAltersHurdleratesonriskanalysisieMa	Q22_3ALTERHRQUALFRAMEAltersHurdleratesonQualitative	Q22_3ALTERHRPLANAltersHurdleratesonPlanningorGeogra	Q23_1RLVDoesyourcompanyutilisetheresidualandvaluem	Q23_2DCFDoesyourcompanyutilisetheDiscountedCashflowM	Q23_3RESACCFLOWDoesyourcompanyutilisetheResidualAcc	Q23_4MARKCOMPDoesyourcompanyutilisetheMarketComparis
Mann-Whitney U	3028.500	3749.000	4032.000	3828.000	3937.500	4358.500	3477.500	3868.000	3525.500	3599.500	3083.000	3603.500	3515.000
Wilcoxon W	9023.500	10190.000	6958.000	10731.000	6863.500	7284.500	9693.500	6353.000	9741.500	5877.500	9188.000	5881.500	5793.000
Z	-1.420	-1.651	-1.275	-1.991	-2.487	-.498	-1.506	-.101	-2.342	-.343	-2.271	-.546	-1.138
Asymp. Sig. (2-tailed)	.156	.099	.202	.046	.013	.619	.132	.920	.019	.732	.023	.585	.255

a. Grouping Variable: Q6_Private_Company

F-6: Non-parametric Mann-Whitney U test of 2-independent samples by use of Margin on Revenue and publicly listed company

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q20_10_1MOR_Usage	205	.02	.139	0	1
Q6_1 ASX Listed Public	190	.2947	.45713	.00	1.00

Ranks

	Q6_1 ASX Listed Public	N	Mean Rank	Sum of Ranks
Q20_10_1MOR_Usage	No	134	94.21	12624.00
	Yes	56	98.59	5521.00
	Total	190		

Test Statistics[a]

	Q20_10_1MOR_Usage
Mann-Whitney U	3579.000
Wilcoxon W	12624.000
Z	-2.013
Asymp. Sig. (2-tailed)	.044

a. Grouping Variable: Q6_1 ASX Listed Public

F-7: Non-parametric Mann-Whitney U test of 2-independent samples use of minimum dollar project size and private company showing significance

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q20_7_1MINPROJ$_Usage	205	.05	.226	0	1
Q20_6_1MINPROFIT$_Usage	205	.04	.205	0	1
Q6_Private_Company	193	.61	.490	0	1

Ranks

	Q6_Private_Company	N	Mean Rank	Sum of Ranks
Q20_7_1MINPROJ$_Usage	0	76	92.77	7050.50
	1	117	99.75	11670.50
	Total	193		
Q20_6_1MINPROFIT$_Usage	0	76	93.77	7126.50
	1	117	99.10	11594.50
	Total	193		

Test Statistics[a]

	Q20_7_1MINPROJ$_Usage	Q20_6_1MINPROFIT$_Usage
Mann-Whitney U	4124.500	4200.500
Wilcoxon W	7050.500	7126.500
Z	-2.112	-1.773
Asymp. Sig. (2-tailed)	.035	.076

a. Grouping Variable: Q6_Private_Company

F-8: Non-parametric Mann-Whitney U test of 2-independent samples by use of bespoke feasibility program versus survey variables

Variable Tested	Mann-Whintey U Score	Z - Score	p - vlaue	Median Value	Vs Median of Null	n =	r =	Result	Sig %
Private Company Structure	398.00	-3.105	0.002	0.11	0.63	9	0.224	Less likely to use	95%
Large Project Developer Size	447.00	-1.978	0.048	0.88	0.52	8	0.147	More likely to use	95%
Trader Developer	648.00	-2.096	0.036	0.00	0.33	9	0.143	Less likely to use	95%
Tourist Developer	787.50	-2.841	0.004	0.22	0.03	9	0.189	More likely to use	95%
Publicly Listed	306.50	-3.995	0.000	0.89	0.27	9	0.290	More likely to use	95%
Use of IRR hurdle rate	565.50	-2.351	0.019	0.67	0.30	9	0.163	More likely to use	95%
Alters HR on Planning/Geo basis	473.50	-2.229	0.026	0.29	0.06	7	0.166	More likely to use	95%
Uses DCF Methodology	373.00	-1.968	0.049	0.56	0.48	7	0.147	More likely to use	95%
Years of Experience	530.00	-1.788	0.074	3.38	2.52	9	0.130	Jse increases w/ years	90%
Use specific Go/No-Go Decision	567.00	-1.921	0.055	1.00	0.70	9	0.136	More likely to use	94.5%
Has mechanism for HR Altering	405.00	-1.775	0.076	0.71	0.38	7	0.132	More likely to use	90%
Alters HR based on Risk	432.50	-1.648	0.099	0.57	0.28	7	0.122	More likely to use	90%

Test Statistics[a]

	Q6_Private_Company	Q6_1 ASX Listed Public	Q5_1TRADERDEVIsyourcompanyaTraderDeveloper	Q5_2INVESTORDEVIsyourcompanyaInvestorDeveloper	Q5_3DEVMANIsyourcompanyinvolvedinDevelopmentManagement	Q5_4VALFIRMIsyourcompanyavaluationfirm	Q5_5FUNDSADVISORIsyourcompanyafundsmanageradvisor	Q5_6OTHERDEVIsyourcompanysomethingotherthantheoptions	Q6OWNERSHIPPleaseprovidedetailsontheownershipstructu
Mann-Whitney U	398.000	306.500	648.000	814.500	675.000	832.500	927.000	913.500	306.000
Wilcoxon W	443.000	16777.500	693.000	24250.500	24111.000	24268.500	972.000	958.500	351.000
Z	-3.105	-3.995	-2.096	-1.243	-2.037	-1.514	-.659	-.757	-3.677
Asymp. Sig. (2-tailed)	.002	.000	.036	.214	.042	.130	.510	.449	.000

a. Grouping Variable: Q17_8PROPRIETARYPROGRAMDidyourcompanyhaveitsownprogram

Test Statisticsa

	Q11_Experience_Years	Q20_11QualitativeHurdleRateApproach	Q21HRALTERDoesyourcompanyutiliseaspecificmechanismf	Q22_1HRALTERRAAltersHurdlerateonriskanalysisieMa	Q22_3ALTERHRQUALFRAMEAltersHurdleratesonQualitative	Q22_3ALTERHRPLANAltersHurdleratesonPlanningorGeogra	Q18_B_Binary_Consisten_Decision_Methodology	Q19 Company uses specific hurdle rates
Mann-Whitney U	530.000	738.000	405.000	432.500	574.500	473.500	543.500	705.500
Wilcoxon W	16640.000	783.000	15630.000	15657.500	15799.500	15698.500	13909.500	16636.500
Z	-1.788	-1.316	-1.775	-1.648	-.516	-2.229	-.313	-.834

Asymp. Sig. (2-tailed)	.074	.188	.076	.099	.606	.026	.754	.404

a. Grouping Variable: Q17_8PROPRIETARYPROGRAMDidyourcompanyhaveitsownprogram

Test Statistics[a]

	Number hurdle rates	Q20_1_1 MDC_Usage	Q20_2_1IR R_Usage	@20_4_1R OE_Usage	NPV used	Q20_6_1 MINPROFI T$_Usage	Q20_7_1 MINPROJ$ _Usage	Q20_9_1P aybackPeri od	Q20_10_1 MOR_Usage	Q23_1RLV	Q23_2DCF	Q23_3RES ACCFLOW	Q23_4MA RKCOMP
Mann-Whitney U	810.500	820.500	565.500	787.500	814.500	841.500	832.500	855.000	864.000	492.500	373.000	553.000	552.000
Wilcoxon W	855.500	865.500	20665.500	832.500	859.500	886.500	877.500	900.000	909.000	520.500	15251.000	581.000	15087.000
Z	-.426	-.416	-2.351	-1.034	-.860	-.656	-.729	-.531	-.432	-1.046	-1.968	-.756	-.716
Asymp. Sig. (2-tailed)	.670	.677	.019	.301	.390	.512	.466	.595	.666	.295	.049	.450	.474

a. Grouping Variable: Q17_8PROPRIETARYPROGRAMDidyourcompanyhaveitsownprogram

Ranks

	Q17_BESPOKE FEASIBILITY PROGRAM	N	Mean Rank	Sum of Ranks
Q6_Private_Company	No	184	99.34	18278.00
	Yes	9	49.22	443.00
	Total	193		
Q6_1 ASX Listed Public	No	181	92.69	16777.50
	Yes	9	151.94	1367.50
	Total	190		
Q5_1TRADERDEVIsyourcompanyaTraderDeveloper	No	216	114.50	24732.00
	Yes	9	77.00	693.00
	Total	225		
Q5_2INVESTORDEVIsyourcompanyaInvestorDeveloper	No	216	112.27	24250.50
	Yes	9	130.50	1174.50
	Total	225		
Q5_3DEVMANIsyourcompanyinvolvedinDevelopmentManagement	No	216	111.63	24111.00
	Yes	9	146.00	1314.00
	Total	225		
Q5_4VALFIRMIsyourcompanyavaluationfirm	No	216	112.35	24268.50
	Yes	9	128.50	1156.50
	Total	225		
Q5_5FUNDSADVISORIsyourcompanyafundsmanageradvisor	No	216	113.21	24453.00
	Yes	9	108.00	972.00
	Total	225		
Q5_6OTHERDEVIsyourcompanysomethingotherthantheoptions	No	216	113.27	24466.50
	Yes	9	106.50	958.50
	Total	225		
Q6OWNERSHIPPleaseprovidedetailsontheownershipstructu	No	184	99.84	18370.00
	Yes	9	39.00	351.00
	Total	193		

Ranks

	Q17_BESPOKE FEASIBILITY PROGRAM	N	Mean Rank	Sum of Ranks
Q11_Experience_Years	No	179	92.96	16640.00
	Yes	9	125.11	1126.00
	Total	188		
Q20_11QualitativeHurdleRateApproach	No	196	103.73	20332.00
	Yes	9	87.00	783.00
	Total	205		
Q21HRALTERDoesyourcompanyutiliseaspecificmechanismf	No	174	89.83	15630.00
	Yes	7	120.14	841.00
	Total	181		
Q22_1HRALTERRAAltersHurdleratesonriskanalysisieMa	No	174	89.99	15657.50
	Yes	7	116.21	813.50
	Total	181		
Q22_3ALTERHRQUALFRAMEAltersHurdleratesonQualitative	No	174	90.80	15799.50
	Yes	7	95.93	671.50
	Total	181		
Q22_3ALTERHRPLANAltersHurdleratesonPlanningorGeogra	No	174	90.22	15698.50
	Yes	7	110.36	772.50
	Total	181		
Q18_B_Binary_Consisten_Decision_Methodology	No	163	85.33	13909.50
	Yes	7	89.36	625.50
	Total	170		
Q19 Company uses specific hurdle rates	No	178	93.46	16636.50
	Yes	9	104.61	941.50
	Total	187		

Ranks

	Q17_BESPOKE FEASIBILITY PROGRAM	N	Mean Rank	Sum of Ranks
Number of specific hurdle rates	No	196	103.36	20259.50
	Yes	9	95.06	855.50
	Total	205		
Q20_1_1MDC_Usage	No	196	103.31	20249.50
	Yes	9	96.17	865.50

	Total	205		
Q20_2_1IRR_Usage	No	200	103.33	20665.50
	Yes	9	142.17	1279.50
	Total	209		
@20_4_1ROE_Usage	No	196	103.48	20282.50
	Yes	9	92.50	832.50
	Total	205		
NPV used	No	196	103.34	20255.50
	Yes	9	95.50	859.50
	Total	205		
Q20_6_1MINPROFIT$_Usage	No	196	103.21	20228.50
	Yes	9	98.50	886.50
	Total	205		
Q20_7_1MINPROJ$_Usage	No	196	103.25	20237.50
	Yes	9	97.50	877.50
	Total	205		
Q20_9_1PaybackPeriodYears_Usage	No	196	103.14	20215.00
	Yes	9	100.00	900.00
	Total	205		
Q20_10_1MOR_Usage	No	196	103.09	20206.00
	Yes	9	101.00	909.00
	Total	205		
Q23_1RLVDoesyourcompanyutilisetheresiduallandvaluem	No	171	90.12	15410.50
	Yes	7	74.36	520.50
	Total	178		
Q23_2DCFDoesyourcompanyutilisetheDiscountedCashflowM	No	172	88.67	15251.00
	Yes	7	122.71	859.00
	Total	179		
Q23_3RESACCFLOWDoesyourcompanyutilisetheResidualAcc	No	171	89.77	15350.00
	Yes	7	83.00	581.00
	Total	178		
Q23_4MARKCOMPDoesyourcompanyutilisetheMarketComparis	No	170	88.75	15087.00
	Yes	7	95.14	666.00
	Total	177		

F-9: Non-parametric Mann-Whitney U test of 2-independent samples by use of Microsoft Excel for feasibility analysis and the use of specific risk analysis methods. Showing 95% statistical significance for use of single-variable sensitivity analysis

Ranks

	Q17_2EXCELDoesyourcompany useMicrosoftExcel	N	Mean Rank	Sum of Ranks
Q27_b_No_of_Risk_Analysis_Methods	No	135	109.99	14849.00
	Yes	90	117.51	10576.00
	Total	225		
Q27_1SENANALYSISDoesyourcompanyuseSensitivityAnalysiso	No	93	101.18	9409.50
	Yes	86	77.91	6700.50
	Total	179		
Q27_2SCENANALYSISDoesyourcompanyuseScenarioAnalysisof	No	92	90.59	8334.50
	Yes	83	85.13	7065.50
	Total	175		
Q27_3MCANALYSISMonteCarloSimulationsasariskanalysism	No	92	90.16	8294.50
	Yes	83	85.61	7105.50
	Total	175		
Q27_4QUALMATRIXQualitativeRiskMatrixasariskanalysism	No	92	89.36	8221.50
	Yes	83	86.49	7178.50
	Total	175		
Q27_5PROPANALYSISProbabilityAnalysisBayesianModelsasa	No	92	87.21	8023.00
	Yes	83	88.88	7377.00
	Total	175		
Q27_6ROANALYSISRealOptionModelsasariskanalysismethod	No	92	87.26	8027.50
	Yes	83	88.83	7372.50
	Total	175		
Q27_7OTHERANALYSISOtherpleasespecifyasariskanalysis	No	92	86.91	7996.00
	Yes	83	89.20	7404.00
	Total	175		

Test Statistics[a]

	Q27_b_No_of_Risk_Analysis_Methods	Q27_1SENANALYSISDoesyourcompanyuseSensitivityAnalysiso	Q27_2SCENANALYSISDoesyourcompanyuseScenarioAnalysisof	Q27_3MCANALYSISMonteCarloSimulationsasariskanalysism	Q27_4QUALMATRIXQualitativeRiskMatrixasariskanalysism	Q27_5PROPANALYSISProbabilityAnalysisBayesianModelsasa	Q27_6ROANALYSISRealOptionModelsasariskanalysismethod	Q27_7OTHERANALYSISOtherpleasespecifyasariskanalysis
Mann-Whitney U	5669.000	2959.500	3579.500	3619.500	3692.500	3745.000	3749.500	3718.000
Wilcoxon W	14849.000	6700.500	7065.500	7105.500	7178.500	8023.000	8027.500	7996.000
Z	-.905	-3.719	-.842	-1.550	-.653	-.480	-.487	-.493
Asymp. Sig. (2-tailed)	.366	.000	.400	.121	.514	.631	.626	.622

a. Grouping Variable: Q17_2EXCELDoesyourcompanyuseMicrosoftExcel

F-10: Non-parametric Mann-Whitney U test of 2-independen samples use of Q6_1a ASX or other Exchange Publicly Listed and the use of specific risk analysis methods (Showing no significance 95% for all methods except for Other)

Ranks

	Q6_1 ASX Listed Public	N	Mean Rank	Sum of Ranks
Q27_b_No_of_Risk_Analysis_Methods	No	134	98.80	13239.00
	Yes	56	87.61	4906.00
	Total	190		
Q27_1SENANALYSISDoesyourcompanyuseSensitivityAnalysiso	No	127	91.22	11584.50
	Yes	50	83.37	4168.50
	Total	177		
Q27_2SCENANALYSISDoesyourcompanyuseScenarioAnalysisof	No	127	85.19	10819.50
	Yes	46	91.99	4231.50
	Total	173		
Q27_3MCANALYSISMonteCarloSimulationsasariskanalysism	No	127	85.91	10910.00
	Yes	46	90.02	4141.00
	Total	173		
Q27_4QUALMATRIXQualitativeRiskMatrixasariskanalysism	No	127	84.85	10776.50
	Yes	46	92.92	4274.50
	Total	173		
Q27_5PROPANALYSISProbabilityAnalysisBayesianModelsasa	No	127	85.95	10915.50
	Yes	46	89.90	4135.50
	Total	173		
Q27_6ROANALYSISRealOptionModelsasariskanalysismethod	No	127	86.95	11042.50
	Yes	46	87.14	4008.50
	Total	173		
Q27_7OTHERANALYSISOtherpleasespecifyasariskanalysis	No	127	89.98	11428.00
	Yes	46	78.76	3623.00
	Total	173		

Appendix F -Non-Parametric Tests of Independent Samples

Test Statistics[a]

	Q27_b_No_of_Risk_Analysis_Methods	Q27_1SENANALYSISDoesyourcompanyuseSensitivityAnalysiso	Q27_2SCENANALYSISDoesyourcompanyuseScenarioAnalysisof	Q27_3MCANALYSISMonteCarloSimulationsasariskanalysism	Q27_4QUALMATRIXQualitativeRiskMatrixasariskanalysism	Q27_5PROPANALYSISProbabilityAnalysisBayesianModelsasa	Q27_6ROANALYSISRealOptionModelsasariskanalysismethod	Q27_7OTHERANALYSISOtherpleasespecifyasariskanalysis
Mann-Whitney U	3310.000	2893.500	2691.500	2782.000	2648.500	2787.500	2914.500	2542.000
Wilcoxon W	4906.000	4168.500	10819.500	10910.000	10776.500	10915.500	11042.500	3623.000
Z	-1.408	-1.139	-.930	-1.242	-1.622	-1.005	-.053	-2.175
Asymp. Sig. (2-tailed)	.159	.255	.353	.214	.105	.315	.958	.030

a. Grouping Variable: Q6_1 ASX Listed Public

F-11: Non-parametric Mann-Whitney U test of 2-independent samples by use of Q18_B binary consistent decision-making methodology and the use of specific risk analysis methods
(Showing no significance 95%)

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q27_b_No_of_Risk_Analysis_Methods	225	1.20	.893	0	5
Q27_1SENANALYSISDoesyourcompanyuseSensitivityAnalysiso	179	.68	.467	0	1
Q27_2SCENANALYSISDoesyourcompanyuseScenarioAnalysisof	175	.39	.490	0	1
Q27_3MCANALYSISMonteCarloSimulationsasariskanalysism	175	.05	.222	0	1
Q27_4QUALMATRIXQualitativeRiskMatrixasariskanalysism	175	.13	.332	0	1
Q27_5PROPANALYSISProbabilityAnalysisBayesianModelsasa	175	.07	.263	0	1
Q27_6ROANALYSISRealOptionModelsasariskanalysismethod	175	.06	.243	0	1
Q27_7OTHERANALYSISOtherpleasespecifyasariskanalysis	175	.14	.351	0	1
Q18_B_Binary_Consisten_Decision_Methodology	170	.81	.392	0	1

Ranks

	Q18_B_Binary_Consisten_Decision_Methodology	N	Mean Rank	Sum of Ranks
Q27_b_No_of_Risk_Analysis_Methods	Disagree or Strongly Disagree	32	80.97	2591.00
	Strongly Agree or Agree	138	86.55	11944.00
	Total	170		
Q27_1SENANALYSISDoesyourcompanyuseSensitivityAnalysiso	Disagree or Strongly Disagree	32	83.09	2659.00
	Strongly Agree or Agree	137	85.45	11706.00
	Total	169		
	Disagree or Strongly Disagree	32	81.72	2615.00

Q27_2SCENANALYSISDoesyour companyuseScenarioAnalysisof	Strongly Agree or Agree	138	86.38	11920.00
	Total	170		
Q27_3MCANALYSISMonteCarlo Simulationsasariskanalysism	Disagree or Strongly Disagree	32	83.66	2677.00
	Strongly Agree or Agree	138	85.93	11858.00
	Total	170		
Q27_4QUALMATRIXQualitative RiskMatrixasariskanalysism	Disagree or Strongly Disagree	32	85.13	2724.00
	Strongly Agree or Agree	138	85.59	11811.00
	Total	170		
Q27_5PROPANALYSISProbabilit yAnalysisBayesianModelsasa	Disagree or Strongly Disagree	32	84.81	2714.00
	Strongly Agree or Agree	138	85.66	11821.00
	Total	170		
Q27_6ROANALYSISRealOption Modelsasariskanalysismethod	Disagree or Strongly Disagree	32	87.97	2815.00
	Strongly Agree or Agree	138	84.93	11720.00
	Total	170		
Q27_7OTHERANALYSISOtherple asespecifyasariskanalysis	Disagree or Strongly Disagree	32	89.44	2862.00
	Strongly Agree or Agree	138	84.59	11673.00
	Total	170		

Test Statistics[a]

	Q27_b_No_of_Risk_Analysis_Methods	Q27_1SENANALYSISDoesyourcompanyuseSensitivityAnalysiso	Q27_2SCENANALYSISDoesyourcompanyuseScenarioAnalysisof	Q27_3MCANALYSISMonteCarloSimulationsasariskanalysism	Q27_4QUALMATRIXQualitativeRiskMatrixasariskanalysism	Q27_5PROPANALYSISProbabilityAnalysisBayesianModelsasa	Q27_6ROANALYSISRealOptionModelsasariskanalysismethod	Q27_7OTHERANALYSISOtherpleasespecifyasariskanalysis
Mann-Whitney U	2063.000	2131.000	2087.000	2149.000	2196.000	2186.000	2129.000	2082.000
Wilcoxon W	2591.000	2659.000	2615.000	2677.000	2724.000	2714.000	11720.000	11673.000
Z	-.656	-.311	-.571	-.606	-.082	-.198	-.739	-.833
Asymp. Sig. (2-tailed)	.512	.755	.568	.544	.934	.843	.460	.405

a. Grouping Variable: Q18_B_Binary_Consisten_Decision_Methodology

F-12: Non-parametric Kruskal-Wallace H test of 2-independent samples by use of Q11 experience levels and go/no-go decision basis as well as usage of MDC, IRR and ROE hurdle rates.

(Showing no significance at the 95% level)

Test Statistics[a,b]

	Q18GONOGODECISION	Q19 SPECIFIC HURDLE RATE USED	Q20_1_1MDC_Usage	Q20_2_1IRR_Usage	@20_4_1ROE_Usage
Kruskal-Wallis H	4.383	0.423	1.435	1.634	0.779
df	3	3	3	3	3
Asymp. Sig.	0.223	0.935	0.697	0.652	0.855

a. Kruskal Wallis Test

b. Grouping Variable: Q11_Experience_Years

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q18GONOGODECISIONDoesyourcompanyuseaspecificquan	188	0.72	0.451	0	1
Q19HURDLERATEUSEDoesyourcompanyincorporatespecificf	187	0.78	0.418	0	1
Q20_1_1MDC_Usage	205	0.40	0.491	0	1
Q20_2_1IRR_Usage	209	0.31	0.464	0	1
@20_4_1ROE_Usage	205	0.10	0.304	0	1
Q11_Experience_Years	188	2.56	1.129	1	4

Ranks

Q11_Experience_Years		N	Mean Rank
Q18GONOGODECISION	1 - 2 years experience	43	86.02
	2 - 5 years experience	49	97.98
	5 - 10 years experience	43	103.51
	10+ years experience	53	90.85
	Total	188	
Q19SPECIFIC HURDLE RATES USED	1 - 2 years experience	43	93.26
	2 - 5 years experience	49	95.92
	5 - 10 years experience	43	91.08
	10+ years experience	52	95.22
	Total	187	
Q20_1_1MDC_Usage	1 - 2 years experience	43	88.48
	2 - 5 years experience	49	95.70
	5 - 10 years experience	43	92.85
	10+ years experience	53	99.61
	Total	188	
Q20_2_1IRR_Usage	1 - 2 years experience	43	90.42
	2 - 5 years experience	49	92.69
	5 - 10 years experience	43	92.60
	10+ years experience	53	101.02
	Total	188	
@20_4_1ROE_Usage	1 - 2 years experience	43	92.74
	2 - 5 years experience	49	97.43
	5 - 10 years experience	43	92.74
	10+ years experience	53	94.64
	Total	188	

F-13: Non-parametric Mann-Whitney U test of 2-independent samples between developer typologies and risk tolerance perception score. (Showing association at 95% significance)

Mann-Whitney Test

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q31 b Risk Tolerance Perception	171	-.16	.717	-1	1
Q5_1TRADERDEVIsyourcompanyaTraderDeveloper	225	.32	.468	0	1

Ranks

	Q5_1TRADERDEVIsyourcompanyaTraderDeveloper	N	Mean Rank	Sum of Ranks
Q31 b Risk Tolerance Perception	No	107	79.98	8558.00
	Yes	64	96.06	6148.00
	Total	171		

Test Statistics[a]

	Q31 b Risk Tolerance Perception
Mann-Whitney U	2780.000
Wilcoxon W	8558.000
Z	-2.227
Asymp. Sig. (2-tailed)	.026

a. Grouping Variable: Q5_1TRADERDEVIsyourcompanyaTraderDeveloper

F-14: Non-parametric Mann-Whitney U test of 2-independent samples between developers who use the RLV method, DCF method, RAC method and market comparison method and years' experience (Showing association at 95% significance for RLV)

Report

Q11_Experience_Years

Q23_1RLVDoesyourcompanyutilisetheresiduallandvaluem	N	Median
No	45	2.00
Yes	132	3.00
Total	177	3.00

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q11_Experience_Years	188	2.56	1.129	1	4
Q23_1RLVDoesyourcompanyutilisetheresiduallandvaluem	178	.74	.439	0	1

Ranks

	Q23_1RLVDoesyourcompanyutilisetheresiduallandvaluem	N	Mean Rank	Sum of Ranks
Q11_Experience_Years	No	45	72.41	3258.50
	Yes	132	94.66	12494.50
	Total	177		

Test Statistics[a]

	Q11_Experience_Years
Mann-Whitney U	2223.500
Wilcoxon W	3258.500
Z	-2.599
Asymp. Sig. (2-tailed)	.009

a. Grouping Variable: Q23_1RLVDoesyourcompanyutilisetheresidual landvaluem

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q11_Experience_Years	188	2.56	1.129	1	4
Q23_2DCFDoesyourcompanyutilisetheDiscountedCashflowM	179	.49	.501	0	1

Ranks

	Q23_2DCFDoesyourcompanyutilisetheDiscountedCashflowM	N	Mean Rank	Sum of Ranks
Q11_Experience_Years	No	90	86.73	7806.00
	Yes	88	92.33	8125.00
	Total	178		

Test Statistics[a]

	Q11_Experience_Years
Mann-Whitney U	3711.000
Wilcoxon W	7806.000
Z	-.749
Asymp. Sig. (2-tailed)	.454

a. Grouping Variable: Q23_2DCFDoesyourcompanyutilisetheDiscountedCashflowM

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum

Q11_Experience_Years	188	2.56	1.129	1	4
Q23_3RESACCFLOWDoesyourcompanyutilisetheResidualAcc	178	.07	.261	0	1

Ranks

	Q23_3RESACCFLOWDoesyourcompanyutilisetheResidualAcc	N	Mean Rank	Sum of Ranks
Q11_Experience_Years	No	164	89.87	14738.00
	Yes	13	78.08	1015.00
	Total	177		

Test Statistics[a]

	Q11_Experience_Years
Mann-Whitney U	924.000
Wilcoxon W	1015.000
Z	-.825
Asymp. Sig. (2-tailed)	.409

a. Grouping Variable: Q23_3RESACCFLOWDoesyourcompanyutilisetheResidualAcc

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q11_Experience_Years	188	2.56	1.129	1	4
Q23_4MARKCOMPDoesyourcompanyutilisetheMarketComparis	177	.07	.262	0	1

Ranks

	Q23_4MARKCOMPDoesyourcompanyutilisetheMarketComparis	N	Mean Rank	Sum of Ranks
Q11_Experience_Years	No	164	89.61	14695.50
	Yes	13	81.35	1057.50
	Total	177		

Test Statistics[a]

	Q11_Experience_Years
Mann-Whitney U	966.500
Wilcoxon W	1057.500
Z	-.578
Asymp. Sig. (2-tailed)	.563

a. Grouping Variable: Q23_4MARKCOMPDoesyourcompanyutilisetheMarketComparis

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F-15: Kruskal-Wallace Test for categories of experience and independent variables

Appendix F -Non-Parametric Tests of Independent Samples

Variable Tested	Kruskall-Wallis H	*Z* - Score	*p* - vlaue	Median Value	Vs Median of Null	*n* =	df	Result	Sig %
Group 1: 0 - 2 years experience						43	3		
Q18 go/no-go decision basis	0.25	0.00	0.22	127.00	46.00			No association	95%
Q19 Use of specific hurdle rates	0.35	0.00	0.00	85.91	91.99			No association	95%
	0.00	No		127.00	46.00	173	3		
MDC Usage	0.10	0.00	0.00	0.00	0.00			No association	95%
IRR Usage	0.00	0.00	0.00	0.00	0.00			No association	95%
ROE Usage	0.03	0.00	0.00	0.89	0.27			No association	95%
Group 2: 2 - 5 years experience						49	3		
Q18 go/no-go decision basis	Yes	No	0.22	127.00	46.00			No association	95%
Q19 Use of specific hurdle rates	50.00	127.00	46.00	85.95	92.92			No association	95%
MDC Usage	4168.50	10819.50	4231.50	0.00	0.00			No association	95%
IRR Usage	0.00	0.00	0.00	0.00	0.00			No association	95%
ROE Usage	0.00	0.00	0.00	0.89	0.27			No association	95%
Group : -5 - 10 years experience						43	3		
Q18 go/no-go decision basis	Yes	No	0.22	127.00	46.00			No association	95%
Q19 Use of specific hurdle rates	46.00	127.00	46.00	89.98	87.14			No association	95%
MDC Usage	4141	10777	4275	0.00	0.00			No association	95%
IRR Usage	0.00	0.00	0.00	0.00	0.00			No association	95%
ROE Usage	0.00	0.00	0.00	0.89	0.27			No association	95%
Group 4: +10 years experience						53	3		
Q18 go/no-go decision basis	Yes	No	0.22	0.00	0.00			No association	95%
Q19 Use of specific hurdle rates	46.00	127.00	46.00	0.00	0.00			No association	95%
MDC Usage	4136	11043	4009	0.00	0.00			No association	95%
IRR Usage	0.00	0.00	0.00	0.00	0.00			No association	95%
ROE Usage	0.00	0.00	0.00	0.89	0.27			No association	95%
						188			

Appendix G – T-test of independent samples

G -1: From section 6.4.3 RQ3 Independent t-test between th use of proprietary feasibility programs and number of hurdle rates used, MDC, IRR and ROE percentage adopted, number of forecasted variables, the number of level so approval required to proceed and the years of experience of survey respondents.

T- Test Group Statistics

	Q16 Uses a proprietary feasibility program	N	Mean	Std. Deviation	Std. Error Mean
Number of specific hurdle rates	No	88	1.22	1.351	.144
	Yes	100	1.78	1.411	.141
MDC percentage	No	30	19.6000	3.84708	.70238
	Yes	52	19.1346	2.96403	.41104
IRR percentage	No	28	16.8036	4.31693	.81582
	Yes	38	19.2237	4.96841	.80598
ROE percentage	No	6	31.6667	29.09754	11.87902
	Yes	15	38.6667	24.81839	6.40808
Q28_Forecast_Var_Num	No	69	9.09	4.562	.549
	Yes	86	9.47	4.332	.467
Num_Levels_Approve_Proceed	No	69	1.42	1.006	.121
	Yes	86	1.35	.716	.077
Q11_Experience_Years	No	88	2.60	1.078	.115
	Yes	100	2.53	1.176	.118

Independent Samples Test

		Levene's Test for Equality		t-test for Equality			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Number of specific hurdle rates	Equal variances assumed	1.518	0.220	-2.789	186	0.006	-0.564
	Equal variances not assumed			-2.797	184.655	0.006	-0.564
MDC percentage	Equal variances assumed	0.046	0.830	0.613	80	0.542	0.46538
	Equal variances not assumed			0.572	48.997	0.570	0.46538
IRR percentage	Equal variances assumed	0.277	0.600	-2.065	64	0.043	-2.42011
	Equal variances not assumed			-2.110	62.192	0.039	-2.42011
ROE percentage	Equal variances assumed	0.002	0.963	-0.557	19	0.584	-7.00000
	Equal variances not assumed			-0.519	8.089	0.618	-7.00000
Q28_Forecast_Var_Num	Equal variances assumed	0.837	0.362	-0.527	153	0.599	-0.378
	Equal variances not assumed			-0.524	142.368	0.601	-0.378
Num_Levels_Approve_Proceed	Equal variances assumed	1.704	0.194	0.516	153	0.607	0.071
	Equal variances not assumed			0.498	118.772	0.620	0.071
Q11_Experience_Years	Equal variances assumed	2.617	0.107	0.437	186	0.663	0.072
	Equal variances not assumed			0.440	185.681	0.661	0.072

G -2: From section 6.3.6 Independent t-test by New Zealand and Australian respondent developers and go/no-go decision processes, use of specific hurdle rates and usage of MDC, IRR and ROE:

Group Statistics

	Geography Condensed to Australia New Zealand or Other	N	Mean	Std. Deviation	Std. Error Mean
Number of specific hurdle rates	Aus	171	1.37	1.250	.096
	NZ	14	1.93	1.940	.518
Q28_Forecast_Var_Num	Aus	134	9.21	4.430	.383
	NZ	11	10.64	3.355	1.012
MDC percentage	Aus	71	19.4507	3.35001	.39757
	NZ	7	17.4286	3.35942	1.26974
IRR percentage	Aus	56	18.6071	4.94305	.66054
	NZ	4	17.5000	2.88675	1.44338
ROE percentage	Aus	16	35.3125	25.13091	6.28273
	NZ	3	56.6667	27.53785	15.89899

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Number of specific hurdle rates	Equal variances assumed	9.247	0.003	-1.537	183	0.126
	Equal variances not assumed			-1.062	13.898	0.306
Q28_Forecast_Var_Num	Equal variances assumed	2.142	0.145	-1.043	143	0.299
	Equal variances not assumed			-1.320	13.048	0.210
MDC percentage	Equal variances assumed	0.801	0.374	1.523	76	0.132
	Equal variances not assumed			1.520	7.228	0.171
IRR percentage	Equal variances assumed	0.489	0.487	0.440	58	0.661
	Equal variances not assumed			0.697	4.378	0.521
ROE percentage	Equal variances assumed	0.096	0.760	-1.335	17	0.200
	Equal variances not assumed			-1.249	2.665	0.310

G -3: From section 6.3.6 Independent t-test between public and private structures and risk tollerance percetpion

Group Statistics

	Q6c Public or Private structure	N	Mean	Std. Deviation	Std. Error Mean
Q31 b Risk Tolerance Perception	Public	50	-.12	.689	.097
	Private	110	-.11	.721	.069

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Q31 b Risk Tolerance Perception	Equal variances assumed	0.269	0.605	-0.090	158	0.928
	Equal variances not assumed			-0.091	98.890	0.927

G -4: From section 6.3.6 Independent t-test between having a property qualification and years of industry experience

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Q11_Experience_Years	188	2.56	1.129	1	4
Q11 Experience > 5 years	188	.51	.501	0	1
Q13_Property_Qualification	182	.84	.372	0	1

Ranks

	Q13_Property_Qualification	N	Mean Rank	Sum of Ranks
Q11_Experience_Years	No	30	89.27	2678.00
	Yes	152	91.94	13975.00
	Total	182		
Q11 Experience > 5 years	No	30	90.00	2700.00
	Yes	152	91.80	13953.00
	Total	182		

Test Statistics[a]

	Q11_Experience_ Years	Q11 Experience > 5 years
Mann-Whitney U	2213.000	2235.000
Wilcoxon W	2678.000	2700.000
Z	-.263	-.197
Asymp. Sig. (2-tailed)	.793	.844

a. Grouping Variable: Q13_Property_Qualification

G -5: From section 6.3.6 Independent t-test on property type and hurdle rates:

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q20_1_2MDCHurdleRateMarginonDevCostMDCorROC_percent	Equal variances assumed	1.984	.163	-.059	80	.953	-.04489	.76665	-1.57057	1.48079
	Equal variances not assumed			-.066	77.450	.948	-.04489	.67976	-1.39834	1.30856
Q20_2_2IRRHurdleRateInternalRateofReturnIRR_percent	Equal variances assumed	.002	.961	-3.265	64	.002	-3.63056	1.11211	-5.85225	-1.40886
	Equal variances not assumed			-3.274	62.485	.002	-3.63056	1.10905	-5.84718	-1.41393
@20_3_2TIRRHurdleRateTargetIRR_percent	Equal variances assumed	.047	.831	-1.611	28	.118	-2.32579	1.44387	-5.28343	.63185
	Equal variances not assumed			-1.608	25.799	.120	-2.32579	1.44651	-5.30026	.64867
Q20_4_2ROEHurdleRateReturnonEquityROE_percent	Equal variances assumed	.426	.522	-1.027	19	.317	-11.77885	11.47015	-35.78614	12.22844
	Equal variances not assumed			-1.033	15.252	.318	-11.77885	11.40057	-36.04359	12.48590
Q20_6_2MINPROFIT$HurdleRateMinimum$Profit	Equal variances assumed	3.274	.120	28.697	6	.000	9116666.6667	317688.4101	8339311.1310	9894022.2024
	Equal variances not assumed			52.393	5.000	.000	9116666.6667	174005.1085	8669372.2955	9563961.0378
Q20_7_2MINPROJ$HurdleRateMinimum$ProjectSize	Equal variances assumed	27.328	.001	2.199	7	.064	99833333.3333	45409381.2418	-7542790.8008	207209457.4675

	Equal variances not assumed			1.456	2.023	.281	99833333.3333	68589317.2764	-192106318.4999	391772985.1666
Q20_8_2ROIHurdleRateReturnonInvestmentROI	Equal variances assumed	19.980	.003	-2.042	7	.080	-30.00000	14.69069	-64.73796	4.73796
	Equal variances not assumed			-.993	1.029	.499	-30.00000	30.21747	-389.07999	329.07999
Q27_b_No_of_Risk_Analysis_Methods	Equal variances assumed	8.549	.004	-1.965	223	.051	-.234	.119	-.469	.001
	Equal variances not assumed			-2.075	215.940	.039	-.234	.113	-.457	-.012

Group Statistics

	Q7_1RESDEVResidentialDeveloper4160orabove	N	Mean	Std. Deviation	Std. Error Mean
Q20_1_2MDCHurdleRateMarginonDevCostMDCorROC_percent	No	29	19.2759	2.41863	.44913
	Yes	53	19.3208	3.71470	.51025
Q20_2_2IRRHurdleRateInternalRateofReturnIRR_percent	No	30	16.2167	4.42501	.80789
	Yes	36	19.8472	4.55885	.75981
@20_3_2TIRRHurdleRateTargetIRR_percent	No	13	18.6154	3.94838	1.09508
	Yes	17	20.9412	3.89664	.94507
Q20_4_2ROEHurdleRateReturnonEquityROE_percent	No	8	29.3750	25.13357	8.88606
	Yes	13	41.1538	25.75152	7.14219
Q20_6_2MINPROFIT$HurdleRateMinimum$Profit	No	2	10000000.000	.0000	.0000
	Yes	6	883333.333	426223.7284	174005.1085
Q20_7_2MINPROJ$HurdleRateMinimum$ProjectSize	No	3	113333333.333	118462370.9594	68394281.7623
	Yes	6	13500000.000	12660963.6284	5168816.7569
Q20_8_2ROIHurdleRateReturnonInvestmentROI	No	7	20.0000	9.57427	3.61873
	Yes	2	50.0000	42.42641	30.00000
Q20_9_2PBYRSHurdleRatePaybackPeriodYears	No	6	8.333	6.0553	2.4721
	Yes	0[a]	.	.	.
Q20_10_2MORHurdleRateMarginonRevenue	No	0[a]	.	.	.
	Yes	2	25.0000	.00000	.00000
Q27_b_No_of_Risk_Analysis_Methods	No	127	1.10	1.030	.091
	Yes	98	1.34	.657	.066

a. t cannot be computed because at least one of the groups is empty.

G -6: From section 6.5.3 Independent t-test on use of Monte Carlo simulations, Real Option theory or Probability/Bayesian models and dependent variables

Group Statistics

	Q27 Uses Monte Carlo, Real Option or Probability/Bayesian	N	Mean	Std. Deviation	Std. Error Mean
Q11_Experience_Years	No	140	2.61	1.142	.097
	Yes	35	2.40	1.143	.193
Num_Levels_Approve_Proceed	No	115	1.29	.659	.061
	Yes	31	1.77	1.359	.244
Q10DEVSIZEDominantSizeofProjectin$orifmorethanone	No	134	51996268.66	40084239.129	3462750.855
	Yes	35	64642857.14	39459318.483	6669842.181
Number of specific hurdle rates	No	140	1.58	1.368	.116
	Yes	35	1.69	1.586	.268
Q27_b_No_of_Risk_Analysis_Methods	No	140	1.38	.487	.041
	Yes	35	2.20	1.023	.173
Q31 b Risk Tolerance Perception	No	137	-.18	.706	.060
	Yes	34	-.12	.769	.132

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Q11_Experience_Years	Equal variances assumed	0.01	0.94	0.96	173.00	0.34
	Equal variances not assumed			0.96	52.31	0.34
Num_Levels_Approve_Proceed	Equal variances assumed	26.39	0.00	-2.82	144.00	0.01
	Equal variances not assumed			-1.94	33.89	0.06
Q10DEVSIZEDominantSizeofProjectin$orifmorethanone	Equal variances assumed	0.27	0.60	-1.67	167.00	0.10

	Equal variances not assumed			-1.68	53.80	0.10
Number of specific hurdle rates	Equal variances assumed	2.29	0.13	-0.40	173.00	0.69
	Equal variances not assumed			-0.37	47.42	0.72
Q27_b_No_of_Risk_Analysis_Methods	Equal variances assumed	13.75	0.00	-6.91	173.00	0.00
	Equal variances not assumed			-4.62	37.93	0.00
Q31 b Risk Tolerance Perception	Equal variances assumed	0.33	0.57	-0.42	169.00	0.68
	Equal variances not assumed			-0.40	47.73	0.69

Appendix H – Chi Square Tests for Independence

H-1 – Chi Square test between education level and obtaining a property qualification

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.065[a]	4	.017
Likelihood Ratio	9.196	4	.056
Linear-by-Linear Association	.030	1	.863
N of Valid Cases	182		

a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is .66.

*Q12_Edcucation_Level_R * Q13PROPERTYQUALWereanyofyourqualificationsinaproper Crosstabulation*
Count

		Q13PROPERTYQUALWereanyofyourqualificationsinaproper		
		No	Yes	Total
Q12_Edcucation_Level_R	Diploma or Trade Certificate	2	6	8
	Master’s Degree	9	52	61
	Post Graduate Diploma	1	17	18
	Professional Degree (JD, MD)	3	1	4
	University Bachelor’s Degree	15	76	91
Total		30	152	182

H-2 - Chi Square and Cramer’s V on Use of MDC as a hurdle rate and Developer Type: Yes, there is an association

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14.212[a]	5	.014
Likelihood Ratio	15.670	5	.008
Linear-by-Linear Association	.292	1	.589
N of Valid Cases	193		

a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is 3.40.

*Q20_1_1MDCDoyouuseMDCROCasahurdlerate * Q5_Developer_Type Crosstabulation*
Count

	Q5_Developer_Type						
	Other	Trader Dev	Investor Dev	Dev Mngmt	Valuation	Funds Mngmt	Total
Q20_1_1MDCDoyouuseMDCROCasahurdle rate No	12	31	19	34	10	5	111
Yes	1	40	12	17	9	3	82
Total	13	71	31	51	19	8	193

H-3 – Chi Square test between use of go/no-go hurdle rates and use of MDC

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	13.204[a]	1	.000		
Continuity Correction[b]	12.043	1	.001		
Likelihood Ratio	13.886	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	13.134	1	.000		
N of Valid Cases	188				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 23.12.
b. Computed only for a 2x2 table

H-4 – Chi Square test between use of go/no-go hurdle rates and use of IRR

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.232[a]	1	.013		
Continuity Correction[b]	5.410	1	.020		
Likelihood Ratio	6.588	1	.010		
Fisher's Exact Test				.017	.009
Linear-by-Linear Association	6.198	1	.013		
N of Valid Cases	188				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.32.
b. Computed only for a 2x2 table

H-5 – Chi Square test between use of go/no-go hurdle rates and use of Qualitative Approach

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	81.874[a]	1	.000		
Continuity Correction[b]	78.018	1	.000		
Likelihood Ratio	78.175	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	81.439	1	.000		
N of Valid Cases	188				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.02.
b. Computed only for a 2x2 table

H-6 – Chi Square test for association of differences between Australian and New Zealand based respondents. Showing significance for Minimum Profit dollar amount and Minimum Project Size. No significance for the number of hurdles used

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Geography Condensed to Australia New Zealand or Other * Q18_B_Binary_Consisten_Decision_Methodology	157	68.3%	73	31.7%	230	100.0%
Geography Condensed to Australia New Zealand or Other * Q19 Company uses specific hurdle rates	172	74.8%	58	25.2%	230	100.0%
Geography Condensed to Australia New Zealand or Other * Q20_1_1MDC_Usage	185	80.4%	45	19.6%	230	100.0%
Geography Condensed to Australia New Zealand or Other * Q20_2_1IRR_Usage	185	80.4%	45	19.6%	230	100.0%
Geography Condensed to Australia New Zealand or Other * @20_3_1TIRR_Usage	185	80.4%	45	19.6%	230	100.0%

Geography Condensed to Australia New Zealand or Other * @20_4_1ROE_Usage	185	80.4%	45	19.6%	230	100.0%
Geography Condensed to Australia New Zealand or Other * NPV used	185	80.4%	45	19.6%	230	100.0%
Geography Condensed to Australia New Zealand or Other * Q20_6_1MINPROFIT$_Usage	185	80.4%	45	19.6%	230	100.0%
Geography Condensed to Australia New Zealand or Other * Minimum project size	8	3.5%	222	96.5%	230	100.0%
Geography Condensed to Australia New Zealand or Other * Q20_8_1ROI_Usage	185	80.4%	45	19.6%	230	100.0%
Geography Condensed to Australia New Zealand or Other * Q20_9_1PaybackPeriodYears_Usage	185	80.4%	45	19.6%	230	100.0%
Geography Condensed to Australia New Zealand or Other * Q20_10_1MOR_Usage	185	80.4%	45	19.6%	230	100.0%
Geography Condensed to Australia New Zealand or Other * Q20_11QualitativeHurdleRateApproach	185	80.4%	45	19.6%	230	100.0%

Geography Condensed to Australia New Zealand or Other * Q18_B_Binary_Consisten_Decision_Methodology

Crosstab

			Q18_B_Binary_Consisten_Decision_Methodology		
			Disagree or Strongly Disagree	Strongly Agree or Agree	Total
Geography Condensed to Australia New Zealand or Other	Aus	Count	28	115	143
		Expected Count	28.2	114.8	143.0
	NZ	Count	3	11	14
		Expected Count	2.8	11.2	14.0
Total		Count	31	126	157
		Expected Count	31.0	126.0	157.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.027[a]	1	.868		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.027	1	.870		
Fisher's Exact Test				1.000	.550
Linear-by-Linear Association	.027	1	.869		
N of Valid Cases	157				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.76.

b. Computed only for a 2x2 table

Geography Condensed to Australia New Zealand or Other * Q19 Company uses specific hurdle rates

Crosstab

			Q19 Company uses specific hurdle rates		
			No	Yes	Total
Geography Condensed to Australia New Zealand or Other	Aus	Count	30	128	158
		Expected Count	32.2	125.8	158.0
	NZ	Count	5	9	14
		Expected Count	2.8	11.2	14.0
Total		Count	35	137	172
		Expected Count	35.0	137.0	172.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.220[a]	1	.136		
Continuity Correction[b]	1.308	1	.253		
Likelihood Ratio	1.951	1	.162		

Fisher's Exact Test				.164	.128
Linear-by-Linear Association	2.207	1	.137		
N of Valid Cases	172				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.85.

b. Computed only for a 2x2 table

Geography Condensed to Australia New Zealand or Other * Q20_1_1MDC_Usage

Crosstab

			Q20_1_1MDC_Usage		
			No	Yes	Total
Geography Condensed to Australia New Zealand or Other	Aus	Count	100	71	171
		Expected Count	98.9	72.1	171.0
	NZ	Count	7	7	14
		Expected Count	8.1	5.9	14.0
Total		Count	107	78	185
		Expected Count	107.0	78.0	185.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.382[a]	1	.537		
Continuity Correction[b]	.113	1	.737		
Likelihood Ratio	.377	1	.539		
Fisher's Exact Test				.582	.365
Linear-by-Linear Association	.379	1	.538		
N of Valid Cases	185				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.90.

b. Computed only for a 2x2 table

Geography Condensed to Australia New Zealand or Other * Q20_2_1IRR_Usage

Crosstab

			Q20_2_1IRR_Usage		
			No	Yes	Total
Geography Condensed to Australia New Zealand or Other	Aus	Count	116	55	171
		Expected Count	116.5	54.5	171.0
	NZ	Count	10	4	14
		Expected Count	9.5	4.5	14.0
Total		Count	126	59	185
		Expected Count	126.0	59.0	185.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.077[a]	1	.782		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.078	1	.780		
Fisher's Exact Test				1.000	.521
Linear-by-Linear Association	.076	1	.782		
N of Valid Cases	185				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.46.
b. Computed only for a 2x2 table

Geography Condensed to Australia New Zealand or Other * @20_4_1ROE_Usage

Crosstab

			@20_4_1ROE_Usage		
			No	Yes	Total
Geography Condensed to Australia New Zealand or Other	Aus	Count	155	16	171
		Expected Count	153.4	17.6	171.0
	NZ	Count	11	3	14
		Expected Count	12.6	1.4	14.0
Total		Count	166	19	185

		Expected Count	166.0	19.0	185.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.046[a]	1	.153		
Continuity Correction[b]	.946	1	.331		
Likelihood Ratio	1.650	1	.199		
Fisher's Exact Test				.161	.161
Linear-by-Linear Association	2.035	1	.154		
N of Valid Cases	185				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.44.

b. Computed only for a 2x2 table

Geography Condensed to Australia New Zealand or Other * NPV used

Crosstab

			NPV used		
			No	Yes	Total
Geography Condensed to Australia New Zealand or Other	Aus	Count	160	11	171
		Expected Count	159.9	11.1	171.0
	NZ	Count	13	1	14
		Expected Count	13.1	.9	14.0
Total		Count	173	12	185
		Expected Count	173.0	12.0	185.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.011[a]	1	.917		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.010	1	.919		
Fisher's Exact Test				1.000	.623
Linear-by-Linear Association	.011	1	.918		
N of Valid Cases	185				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is .91.

b. Computed only for a 2x2 table

Geography Condensed to Australia New Zealand or Other * Q20_6_1MINPROFIT$_Usage

Crosstab

			Q20_6_1MINPROFIT$_Usage		
			No	Yes	Total
Geography Condensed to Australia New Zealand or Other	Aus	Count	166	5	171
		Expected Count	163.6	7.4	171.0
	NZ	Count	11	3	14
		Expected Count	13.4	.6	14.0
Total		Count	177	8	185
		Expected Count	177.0	8.0	185.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.710[a]	1	.001		
Continuity Correction[b]	6.704	1	.010		
Likelihood Ratio	6.181	1	.013		
Fisher's Exact Test				.016	.016
Linear-by-Linear Association	10.652	1	.001		
N of Valid Cases	185				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is .61.

b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.241	.001
	Cramer's V	.241	.001
N of Valid Cases		185	

Geography Condensed to Australia New Zealand or Other * Minimum project size

Crosstab

			Minimum project size								
			2000000.0	4000000.0	5000000.0	15000000.0	20000000.0	35000000.0	40000000.0	250000000.0	Total
Geography Condensed to Australia New Zealand or Other	Aus	Count	0	0	0	1	1	1	1	1	5
		Expected Count	.6	.6	.6	.6	.6	.6	.6	.6	5.0
	NZ	Count	1	1	1	0	0	0	0	0	3
		Expected Count	.4	.4	.4	.4	.4	.4	.4	.4	3.0
Total		Count	1	1	1	1	1	1	1	1	8
		Expected Count	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.000[a]	7	.333
Likelihood Ratio	10.585	7	.158
Linear-by-Linear Association	1.256	1	.262
N of Valid Cases	8		

a. 16 cells (100.0%) have expected count less than 5. The minimum expected count is .38.

Geography Condensed to Australia New Zealand or Other * Q20_9_1PaybackPeriodYears_Usage

Crosstab

			Q20_9_1PaybackPeriodYears_Usage		
			No	Yes	Total
Geography Condensed to Australia New Zealand or Other	Aus	Count	166	5	171
		Expected Count	166.4	4.6	171.0
	NZ	Count	14	0	14
		Expected Count	13.6	.4	14.0

Total	Count	180	5	185
	Expected Count	180.0	5.0	185.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.421[a]	1	.517		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.798	1	.372		
Fisher's Exact Test				1.000	.672
Linear-by-Linear Association	.418	1	.518		
N of Valid Cases	185				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .38.

b. Computed only for a 2x2 table

H-7 – Chi Square test of independence showing no association between dominant property type development and the use of a go/no-go decision process

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.710[a]	1	.001		
Continuity Correction[b]	6.704	1	.010		
Likelihood Ratio	6.181	1	.013		
Fisher's Exact Test				.016	.016
Linear-by-Linear Association	10.652	1	.001		
N of Valid Cases	185				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is .61.

*Dominant type of property Developed consdensed * Q18GONOGODECISIONDoesyourcompanyuseaspecificquan Crosstabulation*

			Q18GONOGODECISIONDoes yourcompanyuseaspecificquan		
			No	Yes	Total
Dominant type of property Developed consdensed	Residential	Count	25	70	95
		Expected Count	26.8	68.2	95.0
		% of Total	13.3%	37.2%	50.5%
	Commercial	Count	1	8	9
		Expected Count	2.5	6.5	9.0
		% of Total	0.5%	4.3%	4.8%
	Retail	Count	5	13	18
		Expected Count	5.1	12.9	18.0
		% of Total	2.7%	6.9%	9.6%
	Mixed-Use	Count	13	24	37
		Expected Count	10.4	26.6	37.0
		% of Total	6.9%	12.8%	19.7%
	Other	Count	9	20	29
		Expected Count	8.2	20.8	29.0
		% of Total	4.8%	10.6%	15.4%
Total		Count	53	135	188
		Expected Count	53.0	135.0	188.0
		% of Total	28.2%	71.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.461[a]	4	.652
Likelihood Ratio	2.678	4	.613
Linear-by-Linear Association	.881	1	.348
N of Valid Cases	188		

a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 2.54.

*Dominant type of property Developed consdensed * Q18GONOGODECISIONDoesyourcompanyuseaspecificquan Crosstabulation*

			Q18GONOGODECISIONDoes yourcompanyuseaspecificquan		
			No	Yes	Total
Dominant type of property Developed consdensed	Residential	Count	25	70	95
		Expected Count	26.8	68.2	95.0
		% of Total	13.3%	37.2%	50.5%
	Commercial	Count	1	8	9
		Expected Count	2.5	6.5	9.0
		% of Total	0.5%	4.3%	4.8%
	Retail	Count	5	13	18
		Expected Count	5.1	12.9	18.0
		% of Total	2.7%	6.9%	9.6%
	Mixed-Use	Count	13	24	37
		Expected Count	10.4	26.6	37.0
		% of Total	6.9%	12.8%	19.7%
	Other	Count	9	20	29
		Expected Count	8.2	20.8	29.0
		% of Total	4.8%	10.6%	15.4%
Total		Count	53	135	188
		Expected Count	53.0	135.0	188.0
		% of Total	28.2%	71.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.461[a]	4	.652
Likelihood Ratio	2.678	4	.613
Linear-by-Linear Association	.881	1	.348
N of Valid Cases	188		

a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 2.54.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Number of Specific Hurdle Rates Indicated	Equal variances assumed	9.247	.003	-1.537	183	.126	-.560	.365	-1.279	.159
	Equal variances not assumed			-1.062	13.898	.306	-.560	.527	-1.692	.571

H-8 – Chi Square test for independence and association of differences between dominant property type categories and use of MDC as a hurdle rate. Association shown for residential dominant development type and use of MDC as a hurdle rate

*Dominant type of property Developed consdensed * Q20_1_1MDC_Usage Crosstabulation*

			Q20_1_1MDC_Usage		
			No	Yes	Total
Dominant type of property Developed consdensed	Residential	Count	45	53	98
		Expected Count	58.8	39.2	98.0
		% of Total	22.0%	25.9%	47.8%
	Commercial	Count	7	3	10
		Expected Count	6.0	4.0	10.0
		% of Total	3.4%	1.5%	4.9%
	Retail	Count	12	6	18
		Expected Count	10.8	7.2	18.0
		% of Total	5.9%	2.9%	8.8%
	Mixed-Use	Count	24	13	37
		Expected Count	22.2	14.8	37.0
		% of Total	11.7%	6.3%	18.0%
	Other	Count	35	7	42
		Expected Count	25.2	16.8	42.0
		% of Total	17.1%	3.4%	20.5%
Total		Count	123	82	205
		Expected Count	123.0	82.0	205.0
		% of Total	60.0%	40.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	18.740[a]	4	.001
Likelihood Ratio	19.780	4	.001
Linear-by-Linear Association	16.708	1	.000
N of Valid Cases	205		

a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 4.00.

*Q7_1RESDEVResidentialDeveloper4160orabove * Q20_1_1MDC_Usage Crosstabulation*

			Q20_1_1MDC_Usage		
			No	Yes	Total
Q7_1RESDEVResidentialDeveloper4160orabove	No	Count	78	29	107
		Expected Count	64.2	42.8	107.0
		% of Total	38.0%	14.1%	52.2%
	Yes	Count	45	53	98
		Expected Count	58.8	39.2	98.0
		% of Total	22.0%	25.9%	47.8%
Total		Count	123	82	205
		Expected Count	123.0	82.0	205.0
		% of Total	60.0%	40.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	15.513[a]	1	.000		
Continuity Correction[b]	14.409	1	.000		
Likelihood Ratio	15.696	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	15.437	1	.000		
N of Valid Cases	205				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 39.20.

b. Computed only for a 2x2 table

*Dominant type of property Developed consdensed * Q20_2_1IRR_Usage Crosstabulation*

			Q20_2_1IRR_Usage		
			No	Yes	Total
Dominant type of property Developed consdensed	Residential	Count	62	36	98
		Expected Count	67.5	30.5	98.0
		% of Total	29.7%	17.2%	46.9%
	Commercial	Count	7	3	10
		Expected Count	6.9	3.1	10.0
		% of Total	3.3%	1.4%	4.8%
	Retail	Count	10	8	18
		Expected Count	12.4	5.6	18.0
		% of Total	4.8%	3.8%	8.6%
	Mixed-Use	Count	26	11	37
		Expected Count	25.5	11.5	37.0
		% of Total	12.4%	5.3%	17.7%
	Other	Count	39	7	46
		Expected Count	31.7	14.3	46.0
		% of Total	18.7%	3.3%	22.0%
Total		Count	144	65	209
		Expected Count	144.0	65.0	209.0
		% of Total	68.9%	31.1%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.401[a]	4	.078
Likelihood Ratio	9.028	4	.060
Linear-by-Linear Association	5.301	1	.021
N of Valid Cases	209		

a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 3.11.

*Dominant type of property Developed consdensed * @20_4_1ROE_Usage Crosstabulation*

			@20_4_1ROE_Usage		
			No	Yes	Total
Dominant type of property Developed consdensed	Residential	Count	85	13	98
		Expected Count	88.0	10.0	98.0
		% of Total	41.5%	6.3%	47.8%
	Commercial	Count	8	2	10
		Expected Count	9.0	1.0	10.0
		% of Total	3.9%	1.0%	4.9%
	Retail	Count	15	3	18
		Expected Count	16.2	1.8	18.0
		% of Total	7.3%	1.5%	8.8%
	Mixed-Use	Count	36	1	37
		Expected Count	33.2	3.8	37.0
		% of Total	17.6%	0.5%	18.0%
	Other	Count	40	2	42
		Expected Count	37.7	4.3	42.0
		% of Total	19.5%	1.0%	20.5%
Total		Count	184	21	205
		Expected Count	184.0	21.0	205.0
		% of Total	89.8%	10.2%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.477[a]	4	.166
Likelihood Ratio	7.249	4	.123
Linear-by-Linear Association	3.867	1	.049
N of Valid Cases	205		

a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is 1.02.

*Dominant type of property Developed consdensed * Q20_5NPV_Usage Crosstabulation*

			Q20_5NPV_Usage		
			No	Yes	Total
Dominant type of property Developed consdensed	Residential	Count	90	8	98
		Expected Count	90.8	7.2	98.0
		% of Total	43.9%	3.9%	47.8%
	Commercial	Count	9	1	10
		Expected Count	9.3	.7	10.0
		% of Total	4.4%	0.5%	4.9%
	Retail	Count	15	3	18
		Expected Count	16.7	1.3	18.0
		% of Total	7.3%	1.5%	8.8%
	Mixed-Use	Count	35	2	37
		Expected Count	34.3	2.7	37.0
		% of Total	17.1%	1.0%	18.0%
	Other	Count	41	1	42
		Expected Count	38.9	3.1	42.0
		% of Total	20.0%	0.5%	20.5%
Total		Count	190	15	205
		Expected Count	190.0	15.0	205.0
		% of Total	92.7%	7.3%	100.0%

H-9 – Fishers Exact test showing no association between medium and large project sizes and use of NPV as a hurdle rate

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.333[a]	1	.564		
Continuity Correction[b]	.078	1	.780		
Likelihood Ratio	.342	1	.559		
Fisher's Exact Test				.767	.398
Linear-by-Linear Association	.331	1	.565		
N of Valid Cases	157				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.97.

b. Computed only for a 2x2 table

*Medium and Large Size Projects * NPV used Crosstabulation*

			NPV used		
			No	Yes	Total
Medium and Large Size Projects	Medium	Count	56	<5	60
		% within NPV used	38.9%	n<5	38.2%
	Large	Count	88	9	97
		% within NPV used	61.1%	69.2%	61.8%
Total		Count	144	13	157
		% within NPV used	100.0%	100.0%	100.0%

H-10 – Chi Square test of independence showing no association between NPV usage and public, private or other ownership structure

*NPV used * Ownership Public, Private or Other Crosstabulation*

			Ownership Public, Private or Other			
			Public	Private	Other	Total
NPV used	No	Count	60	107	3	170
		% within Ownership Public, Private or Other	93.8%	91.5%	100.0%	92.4%
	Yes	Count	4	10	0	14
		% within Ownership Public, Private or Other	6.3%	8.5%	0.0%	7.6%
Total		Count	64	117	3	184
		% within Ownership Public, Private or Other	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.562[a]	2	.755
Likelihood Ratio	.794	2	.672
Linear-by-Linear Association	.124	1	.724
N of Valid Cases	184		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is .23.

H-11 – Chi Square test of independence between groups of property qualifications and having go/no-go decision processes, use of specific hurdle rates in decision practices and usage of MDC, IRR and ROE

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q13_Property_Qualification * Q18_B_Binary_Consisten_Decision_Methodology	164	71.3%	66	28.7%	230	100.0%
Q13_Property_Qualification * Q19 Company uses specific hurdle rates	181	78.7%	49	21.3%	230	100.0%
Q13_Property_Qualification * Q20_1_1MDC_Usage	182	79.1%	48	20.9%	230	100.0%
Q13_Property_Qualification * Q20_2_1IRR_Usage	182	79.1%	48	20.9%	230	100.0%
Q13_Property_Qualification * @20_4_1ROE_Usage	182	79.1%	48	20.9%	230	100.0%

Q13_Property_Qualification * Q18_B_Binary_Consisten_Decision_Methodology

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.036[a]	1	.154		
Continuity Correction[b]	1.350	1	.245		
Likelihood Ratio	1.872	1	.171		
Fisher's Exact Test				.185	.124
Linear-by-Linear Association	2.023	1	.155		
N of Valid Cases	164				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.30.

b. Computed only for a 2x2 table

Q13_Property_Qualification * Q20_1_1MDC_Usage

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.151[a]	1	.142		
Continuity Correction[b]	1.602	1	.206		
Likelihood Ratio	2.138	1	.144		
Fisher's Exact Test				.162	.103
Linear-by-Linear Association	2.139	1	.144		
N of Valid Cases	182				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.35.

b. Computed only for a 2x2 table

Crosstab

Count

		Q20_1_1MDC_Usage		
		No	Yes	Total
Q13_Property_Qualification	No	13	17	30
	Yes	88	64	152
Total		101	81	182

Q13_Property_Qualification * Q20_2_1IRR_Usage

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.036[a]	1	.850		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.035	1	.851		
Fisher's Exact Test				.837	.503
Linear-by-Linear Association	.035	1	.851		
N of Valid Cases	182				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.55.

b. Computed only for a 2x2 table

Crosstab

Count

		Q20_2_1IRR_Usage		
		No	Yes	Total
Q13_Property_Qualification	No	19	11	30
	Yes	99	53	152
Total		118	64	182

Q13_Property_Qualification * @20_4_1ROE_Usage

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.184[a]	1	.277		
Continuity Correction[b]	.591	1	.442		
Likelihood Ratio	1.071	1	.301		
Fisher's Exact Test				.334	.214
Linear-by-Linear Association	1.177	1	.278		
N of Valid Cases	182				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.30.

b. Computed only for a 2x2 table

Crosstab

Count

		@20_4_1ROE_Usage		
		No	Yes	Total
Q13_Property_Qualification	No	25	5	30
	Yes	137	15	152
Total		162	20	182

H-12 – Chi Square test of independence between groups of those that use proprietary feasibility analysis programs and the use of specific hurdle rates

Crosstab

Count

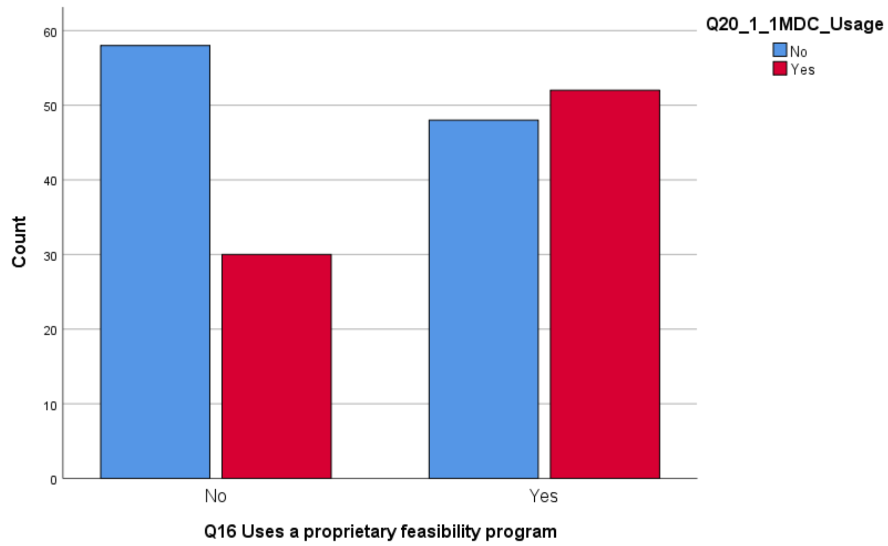
		Q20_1_1MDC_Usage		
		No	Yes	Total
Q16 Uses a proprietary feasibility program	No	58	30	88
	Yes	48	52	100
Total		106	82	188

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.105[a]	1	.013		
Continuity Correction	5.398	1	.020		
Likelihood Ratio	6.154	1	.013		
Fisher's Exact Test				.018	.010
Linear-by-Linear Association	6.072	1	.014		
N of Valid Cases	188				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 38.38.

b. Computed only for a 2x2 table



Crosstab

Count

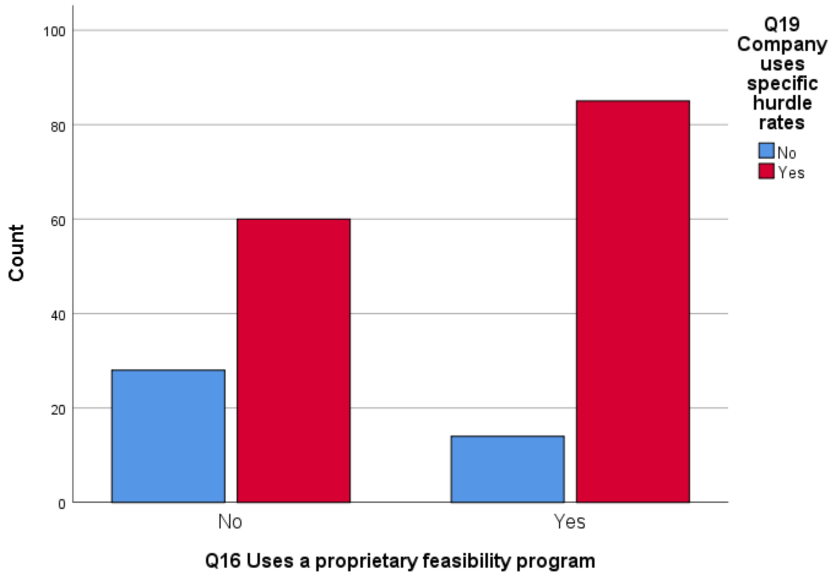
		Q19 Company uses specific hurdle rates		
		No	Yes	Total
Q16 Uses a proprietary feasibility program	No	28	60	88
	Yes	14	85	99
Total		42	145	187

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.359[a]	1	.004		
Continuity Correction[b]	7.375	1	.007		
Likelihood Ratio	8.442	1	.004		
Fisher's Exact Test				.005	.003
Linear-by-Linear Association	8.314	1	.004		
N of Valid Cases	187				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 19.76.

b. Computed only for a 2x2 table



H-13 – Chi Square test of independence between groups of those that use proprietary feasibility analysis programs and adapting or altering hurdle rates based on a change in uncertainty or risk

Crosstab

Count

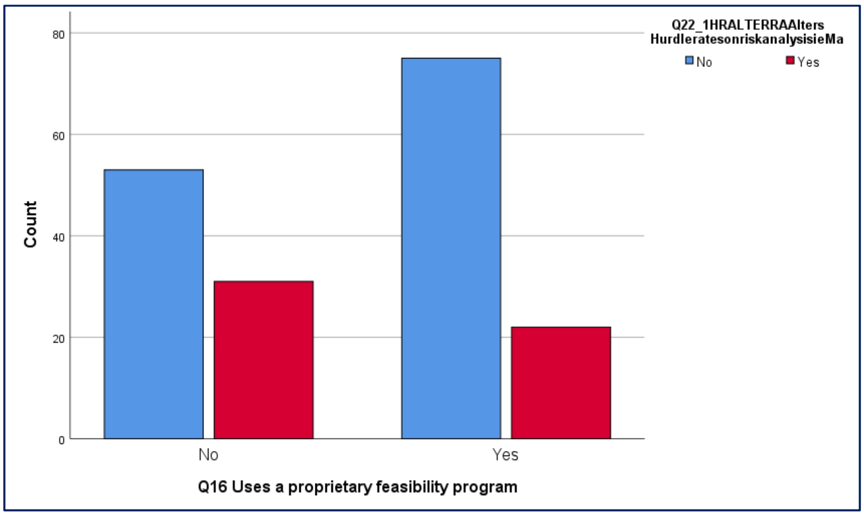
		Q22_1HRALTERRAAltersHurdlerateson riskanalysisieMa		
		No	Yes	Total
Q16 Uses a proprietary feasibility program	No	53	31	84
	Yes	75	22	97
Total		128	53	181

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.399[a]	1	.036		
Continuity Correction[b]	3.738	1	.053		
Likelihood Ratio	4.401	1	.036		
Fisher's Exact Test				.049	.027
Linear-by-Linear Association	4.374	1	.036		
N of Valid Cases	181				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 24.60.

b. Computed only for a 2x2 table



Appendix I - Results of Logistic Binary and Multinomial Regression Analysis

I-1 Binary logistic regression predicting using MDC as a hurdle rate

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Q5_Dev_Type_Condensed	4.906	3	.179
		Q5_Dev_Type_Condensed(1)	.653	1	.419
		Q5_Dev_Type_Condensed(2)	2.928	1	.087
		Q5_Dev_Type_Condensed(3)	.317	1	.574
		Dominant type of property developed	8.783	6	.186
		Dominant type of property developed(1)	.402	1	.526
		Dominant type of property developed(2)	.965	1	.326
		Dominant type of property developed(3)	.402	1	.526
		Dominant type of property developed(4)	2.148	1	.143
		Dominant type of property developed(5)	.143	1	.705
		Dominant type of property developed(6)	2.449	1	.118
		Q10DEVSIZEDominantSizeofProjectin$orifmorethanone	5.174	4	.270
		Q10DEVSIZEDominantSizeofProjectin$orifmorethanone(1)	3.467	1	.063

	Q10DEVSIZEDominantSizeofProjectin$orifmorethanone(2)	.031	1	.860
	Q10DEVSIZEDominantSizeofProjectin$orifmorethanone(3)	2.490	1	.115
	Q10DEVSIZEDominantSizeofProjectin$orifmorethanone(4)	.004	1	.951
	Q12_Edcucation_Level_R	3.118	4	.538
	Q12_Edcucation_Level_R(1)	.948	1	.330
	Q12_Edcucation_Level_R(2)	.160	1	.690
	Q12_Edcucation_Level_R(3)	.402	1	.526
	Q12_Edcucation_Level_R(4)	.000	1	.992
	Q11EXPERIENCEPleaseindicateyourlevelofexperienceint	2.079	3	.556
	Q11EXPERIENCEPleaseindicateyourlevelofexperienceint(1)	1.123	1	.289
	Q11EXPERIENCEPleaseindicateyourlevelofexperienceint(2)	.343	1	.558
	Q11EXPERIENCEPleaseindicateyourlevelofexperienceint(3)	.267	1	.605
	Q13PROPERTYQUALWereanyofyourqualificationsinaproper	.821	1	.365
	Q14DECISIONMAKERIsthereaspecialisedboardseniormanag	.019	1	.890
	Q16FEASOPROGRAMDoesyourcompanyuseaproprietarydevelopme	4.721	1	.030

	Q19HURDLERATEUSEDoesyourcompanyincorporatespecificf	35.419	1	.000
	Q20_2_1IRRDoyouuseIRRasahurdlerate	3.222	1	.073
	Q24RISKMANPLANDoesyourcompanyhaveariskmanagementst	.535	1	.465
	Q31_Risk_Tolerance_Scale	9.381	2	.009
	Q31_Risk_Tolerance_Scale(1)	8.293	1	.004
	Q31_Risk_Tolerance_Scale(2)	.347	1	.556
Overall Statistics		61.212	28	.000

I-2 Binary logistic regression predicting the use of complex quantitative decision methods of large property developers

Binary Logistic Regression -Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 5[e]	Q18 GO/NO-GO Decision Basis	1.417	.707	4.014	1	.045	4.125
	Q14_1BoardorOther_R			14.370	2	.001	
	Q14_1BoardorOther_R(1)	2.025	.746	7.376	1	.007	7.576
	Q14_1BoardorOther_R(2)	2.548	.682	13.939	1	.000	12.780
	Q19 Specific hurdle rate use	1.358	.554	6.012	1	.014	3.889
	Q20 -11 Qualitative Hurdle Rate Approach	2.464	.837	8.656	1	.003	11.748
	Q23-Residual Cashflow Accumulation Method	-1.605	.753	4.547	1	.033	.201
	Constant	-4.561	1.053	18.751	1	.000	.010

e. Variable(s) entered on step 5: Q18 GO/NO- GO Decision Basis.

Classification Table[a]

	Observed		Predicted: Q10BinaryLarge Size is $50 mill or more .00	Predicted: Q10BinaryLarge Size is $50 mill or more 1.00	Percentage Correct
Step 1	Q10BinaryLarge Size is $50 mill or more	.00	43	38	53.1
		1.00	20	63	75.9
	Overall Percentage				64.6
Step 2	Q10BinaryLarge Size is $50 mill or more	.00	53	28	65.4
		1.00	29	54	65.1
	Overall Percentage				65.2
Step 3	Q10BinaryLarge Size is $50 mill or more	.00	49	32	60.5
		1.00	19	64	77.1
	Overall Percentage				68.9
Step 4	Q10BinaryLarge Size is $50 mill or more	.00	52	29	64.2
		1.00	21	62	74.7
	Overall Percentage				69.5
Step 5	Q10BinaryLarge Size is $50 mill or more	.00	46	35	56.8
		1.00	12	71	85.5
	Overall Percentage				71.3

a. The cut value is .500

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	22.961	2	.000
	Block	22.961	2	.000
	Model	22.961	2	.000
Step 2	Step	4.253	1	.039
	Block	27.214	3	.000
	Model	27.214	3	.000
Step 3	Step	5.540	1	.019
	Block	32.754	4	.000
	Model	32.754	4	.000
Step 4	Step	4.482	1	.034
	Block	37.236	5	.000
	Model	37.236	5	.000
Step 5	Step	4.653	1	.031
	Block	41.889	6	.000
	Model	41.889	6	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	204.366[a]	.131	.174
2	200.113[a]	.153	.204
3	194.574[a]	.181	.241
4	190.092[a]	.203	.271
5	185.439[a]	.225	.301

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Appendix J – Analysis of Variance (ANOVA)

J-1 – One way analysis of variance test between dominant property type and percentage of MDC as a minimum hurdle rate for a go/no-go decision

Descriptives

Q20_1_2MDCHurdleRate_percent

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Residential	53	19.3208	3.71470	.51025	18.2969	20.3447	10.00	30.00
Commercial	3	18.0000	3.46410	2.00000	9.3947	26.6053	14.00	20.00
Retail	6	20.8333	2.04124	.83333	18.6912	22.9755	20.00	25.00
Industrial	1	12.0000	.	.	.	.	12.00	12.00
Mixed Use/No Dominant	13	19.0769	1.89128	.52455	17.9340	20.2198	15.00	20.00
Other	4	20.0000	.00000	.00000	20.0000	20.0000	20.00	20.00
Total	80	19.2875	3.33828	.37323	18.5446	20.0304	10.00	30.00

ANOVA

Q20_1_2MDCHurdleRate_percent

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	75.084	5	15.017	1.380	.242
Within Groups	805.304	74	10.882		
Total	880.388	79			

J-2 – One way analysis of variance test between dominant property type and percentage of IRR as a minimum hurdle rate for a go/no-go decision

Descriptives

Q20_2_2IRRHurdleRate_percent

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Residential	36	19.8472	4.55885	.75981	18.3047	21.3897	12.50	30.00
Commercial	3	15.6667	4.04145	2.33333	5.6271	25.7062	12.00	20.00
Retail	8	13.6875	3.65413	1.29193	10.6326	16.7424	10.00	20.00
Mixed-Use	11	15.3636	3.44304	1.03812	13.0506	17.6767	10.00	20.00
Other	8	20.1250	4.48609	1.58607	16.3745	23.8755	15.00	30.00
Total	66	18.1970	4.82133	.59346	17.0117	19.3822	10.00	30.00

ANOVA

Q20_2_2IRRHurdleRate_percent

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	397.974	4	99.493	5.453	.001
Within Groups	1112.966	61	18.245		
Total	1510.939	65			

Multiple Comparisons

Dependent Variable: Q20_2_2IRRHurdleRate_percent

Tukey HSD

(I) Dominant type of property developed consdensed	(J) Dominant type of property developed consdensed	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Residential	Commercial	4.18056	2.56683	.485	-3.0349	11.3960
	Retail	6.15972*	1.66958	.004	1.4665	10.8530
	Mixed-Use	4.48359*	1.47156	.027	.3470	8.6202
	Other	-.27778	1.66958	1.000	-4.9710	4.4155
Commercial	Residential	-4.18056	2.56683	.485	-11.3960	3.0349
	Retail	1.97917	2.89179	.959	-6.1498	10.1081
	Mixed-Use	.30303	2.78217	1.000	-7.5178	8.1238
	Other	-4.45833	2.89179	.540	-12.5873	3.6706
Retail	Residential	-6.15972*	1.66958	.004	-10.8530	-1.4665
	Commercial	-1.97917	2.89179	.959	-10.1081	6.1498
	Mixed-Use	-1.67614	1.98478	.916	-7.2554	3.9032
	Other	-6.43750*	2.13573	.030	-12.4411	-.4339
Mixed-Use	Residential	-4.48359*	1.47156	.027	-8.6202	-.3470
	Commercial	-.30303	2.78217	1.000	-8.1238	7.5178
	Retail	1.67614	1.98478	.916	-3.9032	7.2554
	Other	-4.76136	1.98478	.129	-10.3407	.8179
Other	Residential	.27778	1.66958	1.000	-4.4155	4.9710
	Commercial	4.45833	2.89179	.540	-3.6706	12.5873
	Retail	6.43750*	2.13573	.030	.4339	12.4411
	Mixed-Use	4.76136	1.98478	.129	-.8179	10.3407

*. The mean difference is significant at the 0.05 level.

J-3 – Two-way analysis of variance test between groups of public and private developers and large project sizes (> $50 million) and the number of hurdle rates used as a basis for a go/no-go decision.

Descriptive Statistics

Dependent Variable: Number_Specific_Hurdle Rates

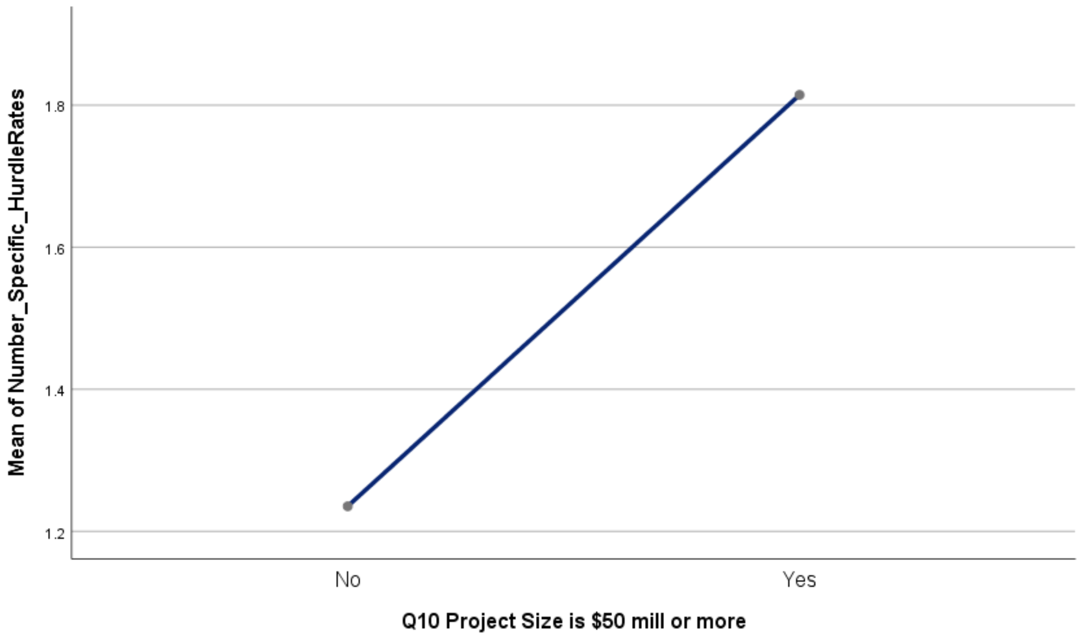
Ownership Public, Private or Other	Q10 Project Size is $50 mill or more	Mean	Std. Deviation	N
Public	No	1.17	.718	12
	Yes	1.49	1.249	47
	Total	1.42	1.163	59
Private	No	1.35	1.283	66
	Yes	2.07	1.776	45
	Total	1.64	1.536	111
Total	No	1.32	1.211	78
	Yes	1.77	1.549	92
	Total	1.56	1.418	170

Tests of Between-Subjects Effects

Dependent Variable: Number_Specific_Hurdle Rates

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	16.592[a]	3	5.531	2.841	.040	.049
Intercept	259.602	1	259.602	133.337	.000	.445
Q6b_Ownership_Condensed	4.059	1	4.059	2.085	.151	.012
Q10ProjectSizeLargeorSmall	7.631	1	7.631	3.919	.049	.023
Q6b_Ownership_Condensed * Q10ProjectSizeLargeorSmall	1.102	1	1.102	.566	.453	.003
Error	323.196	166	1.947			
Total	756.000	170				
Corrected Total	339.788	169				

a. R Squared = .049 (Adjusted R Squared = .032)


Mean of Number_Specific_HurdleRates
1.8
1.6
1.4
1.2
No
Yes
Q10 Project Size is $50 mill or more

J-4 – Two-way analysis of variance test between groups on the basis of developer typologies and the number of specific hurdle rates and forecasted variables as well as the specific levels of MDC, IRR and ROE used.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Number of specific hurdle rates	Between Groups	7.27	2	3.63	1.86	0.16
	Within Groups	292.90	150	1.95		
	Total	300.17	152			
MDC percentage	Between Groups	25.67	2	12.83	1.08	0.35
	Within Groups	784.97	66	11.89		
	Total	810.64	68			
IRR percentage	Between Groups	148.75	2	74.38	3.23	0.05
	Within Groups	1196.65	52	23.01		
	Total	1345.41	54			
ROE percentage	Between Groups	135.21	2	67.60	0.09	0.92
	Within Groups	10308.54	13	792.96		
	Total	10443.75	15			

Tukey HSD

Dependent Variable			Mean Difference	Std. Error	Sig.
IRR percentage	Trader Developer	Investor Developer	4.26*	1.68	0.038
		Development Manager	1.52	1.59	0.605
	Investor Developer	Trader Developer	-4.26*	1.68	0.038
		Development Manager	-2.73	1.97	0.353
	Development Manager	Trader Developer	-1.52	1.59	0.605
		Investor Developer	2.73	1.97	0.353

*The mean difference is significant at the 0.05 level.

		N	Mean	Std. Deviation	Std. Error
	Trader Developer	71	1.66	1.07	0.127
	Investor Developer	31	1.71	1.87	0.335

Number of specific hurdle rates	Development Manager	51	1.22	1.47	0.206
	Total	153	1.52	1.41	0.114
MDC percentage	Trader Developer	40	19.93	3.81	0.602
	Investor Developer	12	18.67	3.77	1.089
	Development Manager	17	18.71	1.99	0.483
	Total	69	19.41	3.45	0.416
IRR percentage	Trader Developer	31	19.48	4.93	0.885
	Investor Developer	11	15.23	4.36	1.313
	Development Manager	13	17.96	4.82	1.338
	Total	55	18.27	4.99	0.673
ROE percentage	Trader Developer	8	39.38	27.05	9.564
	Investor Developer	5	34.00	31.50	14.089
	Development Manager	3	41.67	24.66	14.240
	Total	16	38.13	26.39	6.597

J-5 – One-way analysis of variance test between groups on the basis of small developer (< $5 million project size) and specific level of MDC, IRR and ROE showing no association

Descriptives

			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum	Between-Component Variance
Q20_1_2MDCHurdleRate_percent	No		67	19.3582	3.24598	.39656	18.5665	20.1500	10.00	30.00	
	Yes		13	18.9231	3.90430	1.08286	16.5637	21.2824	12.00	25.00	
	Total		80	19.2875	3.33828	.37323	18.5446	20.0304	10.00	30.00	
	Model	Fixed Effects			3.35568	.37518	18.5406	20.0344			
		Random Effects				.37518[a]	14.5204[a]	24.0546[a]			-.42246
Q20_2_2IRRHurdleRate_percent	No		58	18.3190	5.03906	.66166	16.9940	19.6439	10.00	30.00	
	Yes		7	16.9286	2.83473	1.07143	14.3069	19.5503	12.50	20.00	
	Total		65	18.1692	4.85354	.60201	16.9666	19.3719	10.00	30.00	
	Model	Fixed Effects			4.87228	.60433	16.9616	19.3769			
		Random Effects				.60433[a]	10.4905[a]	25.8480[a]			-.93370
	No		17	34.4118	23.10860	5.60466	22.5304	46.2931	10.00	90.00	
	Yes		4	46.2500	36.82730	18.41365	-12.3505	104.8505	20.00	100.00	

Q20_4_2ROEHurdleRate_percent	Total		21	36.6667	25.56039	5.57773	25.0317	48.3016	10.00	100.00	
	Model	Fixed Effects			25.76500	5.62238	24.8989	48.4345			
		Random Effects				5.62238[a]	-34.7725[a]	108.1058[a]			-32.43205

a. Warning: Between-component variance is negative. It was replaced by 0.0 in computing this random effects measure.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Q20_1_2MDCHurdleRate_percent	Between Groups	2.061	1	2.061	.183	.670
	Within Groups	878.326	78	11.261		
	Total	880.388	79			
Q20_2_2IRRHurdleRate_percent	Between Groups	12.075	1	12.075	.509	.478
	Within Groups	1495.563	63	23.739		
	Total	1507.638	64			
Q20_4_2ROEHurdleRate_percent	Between Groups	453.799	1	453.799	.684	.419
	Within Groups	12612.868	19	663.835		
	Total	13066.667	20			

J-6 – One-way Analysis of Variance test between groups on the basis of use of ROE and number of specific hurdle rates used

Descriptives

Number of specific hurdle rates

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
No	184	1.15	1.120	.083	.99	1.32	0	5
Yes	21	3.48	1.940	.423	2.59	4.36	1	9
Total	205	1.39	1.412	.099	1.20	1.58	0	9

ANOVA

Number of specific hurdle rates

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	101.803	1	101.803	67.763	.000
Within Groups	304.977	203	1.502		
Total	406.780	204			

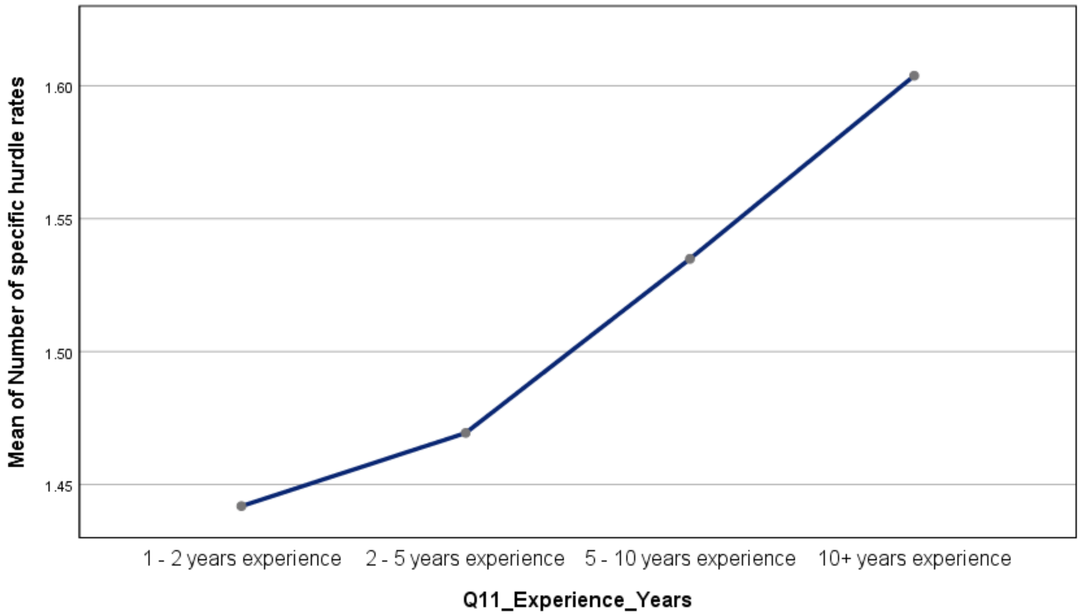
J-7 – One-way Analysis of Variance test between groups on the basis of years of experience and number of specific hurdle rates used and the specific levels adopted

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Q28_Forecast_Var_Num	Between Groups	29.727	3	9.909	.501	.682
	Within Groups	2986.622	151	19.779		
	Total	3016.348	154			
Number of specific hurdle rates	Between Groups	.766	3	.255	.127	.944
	Within Groups	370.186	184	2.012		
	Total	370.952	187			
MDC percentage	Between Groups	32.620	3	10.873	.999	.398
	Within Groups	848.758	78	10.882		
	Total	881.378	81			
IRR percentage	Between Groups	50.127	3	16.709	.709	.550
	Within Groups	1460.812	62	23.561		
	Total	1510.939	65			
ROE percentage	Between Groups	1342.560	3	447.520	.649	.594
	Within Groups	11724.107	17	689.653		
	Total	13066.667	20			

Descriptives

		N	Mean	Std. Deviation	Std. Error
Q28_Forecast _Var_Num	1 - 2 years experience	37	9.30	4.743	0.780
	2 - 5 years experience	34	9.32	5.007	0.859
	5 - 10 years experience	38	8.63	4.290	0.696
	10+ years experience	46	9.83	3.855	0.568
	Total	155	9.30	4.426	0.355
Number of specific hurdle rates	1 - 2 years experience	43	1.44	1.297	0.198
	2 - 5 years experience	49	1.47	1.569	0.224
	5 - 10 years experience	43	1.53	1.594	0.243
	10+ years experience	53	1.60	1.198	0.165
	Total	188	1.52	1.408	0.103
MDC percentage	1 - 2 years experience	16	19.3125	3.84220	0.96055
	2 - 5 years experience	22	20.2273	3.99919	0.85263
	5 - 10 years experience	18	19.2222	2.94170	0.69337
	10+ years experience	26	18.5769	2.40288	0.47124
	Total	82	19.3049	3.29867	0.36428
IRR percentage	1 - 2 years experience	14	16.6429	3.36514	0.89937
	2 - 5 years experience	16	18.1563	5.43973	1.35993
	5 - 10 years experience	14	18.5000	6.53688	1.74705
	10+ years experience	22	19.0227	3.86830	0.82472
	Total	66	18.1970	4.82133	0.59346
ROE percentage	1 - 2 years experience	4	37.5000	35.23729	17.61865
	2 - 5 years experience	7	27.1429	10.35098	3.91230
	5 - 10 years experience	4	36.2500	22.86737	11.43369
	10+ years experience	6	47.5000	34.02205	13.88944
	Total	21	36.6667	25.56039	5.57773


Mean of Number of specific hurdle rates
1.60
1.55
1.50
1.45
1 - 2 years experience
2 - 5 years experience
5 - 10 years experience
10+ years experience
Q11_Experience_Years

J-X – One-way Analysis of Variance test between groups on the basis of preferred project size and risk tolerance perceptions. (In Output 11 01 2019 RQ 2b)

Descriptives

Q31_B_Risk_Tolerance_Numerical

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum	Between-Component Variance
$0 - $5 million		25	.08	.759	.152	-.23	.39	-1	1	
$5 - $10 million		23	-.39	.722	.151	-.70	-.08	-1	1	
$10 - $50 million		34	-.32	.638	.109	-.55	-.10	-1	1	
$50 - $100 million		29	.07	.753	.140	-.22	.36	-1	1	
$100 million +		54	-.13	.674	.092	-.31	.05	-1	1	
Total		165	-.14	.715	.056	-.25	-.03	-1	1	
Model	Fixed Effects			.701	.055	-.25	-.03			
	Random Effects				.092	-.39	.11			.024

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
Q20_2_1IRR_Usage	Based on Mean	16.303	3	166	.000
	Based on Median	4.403	3	166	.005
	Based on Median and with adjusted df	4.403	3	159.119	.005
	Based on trimmed mean	16.303	3	166	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: Q20_2_1IRR_Usage

b. Design: Intercept + Q6b_Ownership_Condensed + Q10ProjectSizeLargeorSmall + Q6b_Ownership_Condensed * Q10ProjectSizeLargeorSmall

ANOVA

Q31_B_Risk_Tolerance_Numerical

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.080	4	1.270	2.581	.039
Within Groups	78.714	160	.492		
Total	83.794	164			

Multiple Comparisons

Dependent Variable: Q31_B_Risk_Tolerance_Numerical

Tukey HSD

(I) Q10DEVSIZEDominantSizeofProjectin$orifmorethanone	(J) Q10DEVSIZEDominantSizeofProjectin$orifmorethanone	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
$0 - $5 million	$5 - $10 million	.471	.203	.142	-.09	1.03
	$10 - $50 million	.404	.185	.191	-.11	.91
	$50 - $100 million	.011	.191	1.000	-.52	.54
	$100 million +	.210	.170	.731	-.26	.68
$5 - $10 million	$0 - $5 million	-.471	.203	.142	-1.03	.09
	$10 - $50 million	-.068	.189	.996	-.59	.45
	$50 - $100 million	-.460	.196	.135	-1.00	.08
	$100 million +	-.262	.175	.565	-.74	.22
$10 - $50 million	$0 - $5 million	-.404	.185	.191	-.91	.11
	$5 - $10 million	.068	.189	.996	-.45	.59
	$50 - $100 million	-.392	.177	.180	-.88	.10
	$100 million +	-.194	.154	.714	-.62	.23
$50 - $100 million	$0 - $5 million	-.011	.191	1.000	-.54	.52
	$5 - $10 million	.460	.196	.135	-.08	1.00
	$10 - $50 million	.392	.177	.180	-.10	.88
	$100 million +	.199	.161	.734	-.25	.64
$100 million +	$0 - $5 million	-.210	.170	.731	-.68	.26
	$5 - $10 million	.262	.175	.565	-.22	.74
	$10 - $50 million	.194	.154	.714	-.23	.62
	$50 - $100 million	-.199	.161	.734	-.64	.25

J-8 – One-way Analysis of Variance test between groups on the basis of small, medium and large project sizes and risk toerence perception score

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.273	2	2.136	4.352	0.014
Within Groups	79.521	162	0.491		
Total	83.794	164			

	N	Mean	Std. Deviation	Std. Error
Small	25	0.08	0.759	0.152
Medium	57	-0.35	0.668	0.088
Large	83	-0.06	0.705	0.077
Total	165	-0.14	0.715	0.056